THE BULLETIN

OF THE

AMERICAN CERAMIC SOCIETY

Volume 16 DECEMBER, 1937 Number 12

W. E. Wells

See page 490 for biography of W. E. Wells

Truer Ware and MORE

Dinnerware manufacturers are enthusiastic in their praise of the LOUTHAN *Hi-Fire* Setter . . . not only because it permits increased kiln production, but because it assures more "firsts." The LOUTHAN Setter is made of a *hard fire* refractory body resistant to thermal shock. Precision formed it retains true alignment through countless "fires" without warping . . . sagging or dunting. It provides a clean, smooth placing surface. It is rugged in structure and will withstand abnormal kiln-room abuse indefinitely.

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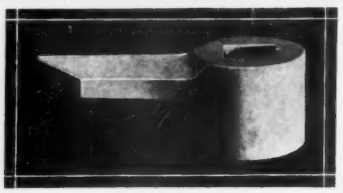

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THE BULLETIN OF THE AMERICAN CERAMIC SOCIETY

Volume 16 December, 1937 Number 12

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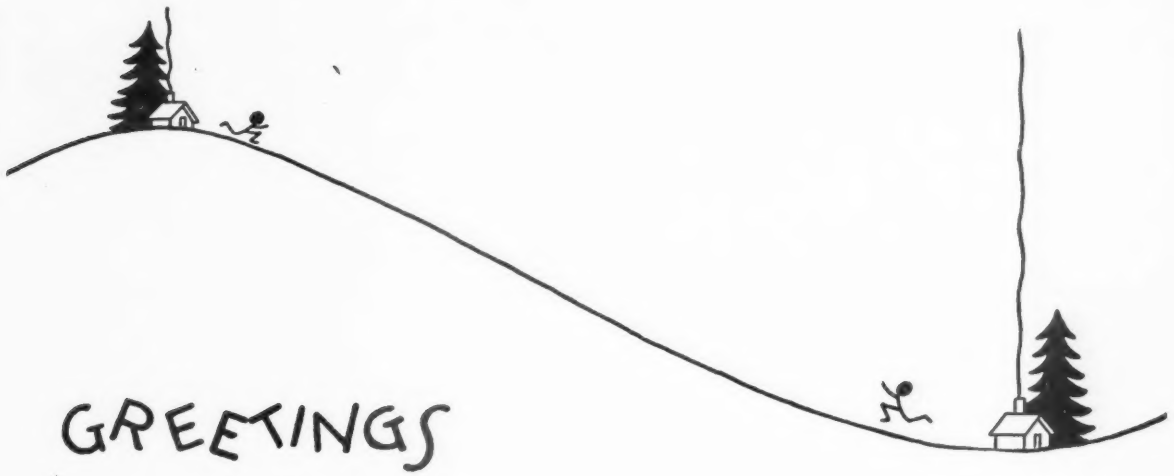

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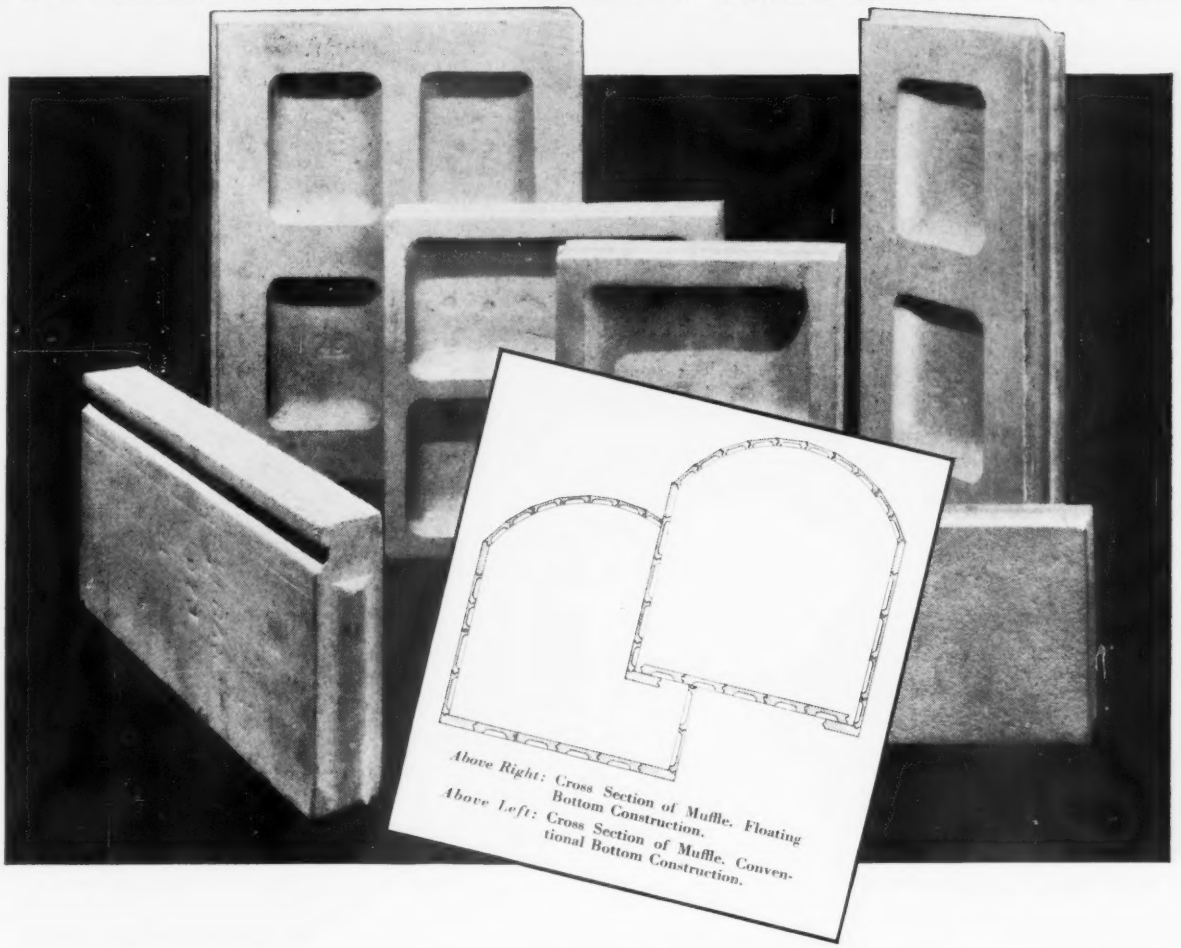

Above Right: Cross Section of Muffle. Floating Bottom Construction.

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Disintegrators
Lancaster Iron Works, Inc.

Dryer (Pipe Rack)
Lancaster Iron Works, Inc.

Drying Machinery
Frazier-Simplex, Inc.
Lancaster Iron Works, Inc.
Proctor & Schwartz, Inc.

Electrocast Refractories
Corhart Refractories Co.

Enameling Equipment (Complete)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Frazier-Simplex, Inc.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Enameling Furnaces
Carborundum Co.
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Electro Refractories & Alloys Corp.
The Hommel Co., O., Inc.
Lancaster Iron Works, Inc.
Norton Co.

Enameling Iron (Sheet)
American Rolling Mill Co.
Bethlehem Steel Co.

Enameling Muffles
Bethlehem Steel Co.
Carborundum Co. (*Carbofrax*)
Chicago Vitreous Enamel Product Co.
Electro Refractories & Alloys Corp.
Frazier-Simplex, Inc.
Norton Co. (*Alundum*)
Pittsburgh Plate Glass Co.

Enameling (Practical Service)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
The Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Enamels
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Pittsburgh Plate Glass Co.
The Porcelain Enamel and Mfg. Co.
The Vitro Mfg. Co.

Enamel Oxide
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.

Enamels (Porcelain)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.
The Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Equipment (Porcelain Enameling)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
The DeVilbiss Co.
The Hommel Co., O., Inc.

Exhaust Systems
The DeVilbiss Co.

Feldspar
Ceramic Color & Chemical Mfg. Co.
Consolidated Feldspar Corp.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Paper Makers Importing Co.
The Porcelain Enamel and Mfg. Co.
Sant, Richard C.
The Vitro Mfg. Co.

Fire Brick
Carborundum Co.
Corhart Refractories Co.
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
Norton Co.

Fire Brick—Process Equipment
Lancaster Iron Works, Inc.

Fire Clay
Spinks Clay Co., H. C.

Flint
Ceramic Color & Chemical Mfg. Co.
Consolidated Feldspar Corp.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Paper Makers Importing Co.
The Porcelain Enamel and Mfg. Co.

Flint Pebbles
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Floors (Non-Slip)
Norton Co.

Fluorspar
Harshaw Chemical Co.

French Flint
Consolidated Feldspar Corp.
Paper Makers Importing Co.

Frit
Allied Engineering Co.
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Frosting Mixtures
Harshaw Chemical Co.

Fuel Oil Systems and Control, Stokers
Bethlehem Steel Co.
Frazier-Simplex, Inc.

Furnaces
Allied Engineering Co.
Carborundum Co. (*Carboradiant*)
Chicago Vitreous Enamel Product Co.
Denver Fire Clay Co.
Frazier-Simplex, Inc.
The Hommel Co., O., Inc.

Glass Bending Ovens, Glass Decorating Machines
Frazier-Simplex, Inc.

Glass Equipment
Hartford-Empire Co.
Lancaster Iron Works, Inc.

Glass Melting Pots (Open and Covered)
Pittsburgh Plate Glass Co.

Glass Melting Tanks and Furnaces
Frazier-Simplex, Inc.
Pittsburgh Plate Glass Co.

Glass Thickness Gauge
Bausch & Lomb Optical Co.

Glaze and Body Spar
Ceramic Color & Chemical Mfg. Co.
Consolidated Feldspar Corp.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Paper Makers Importing Co.
The Porcelain Enamel and Mfg. Co.
The Vitro Mfg. Co.

Glazes and Enamels
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Glaze Spar
Ceramic Color & Chemical Mfg. Co.
Consolidated Feldspar Corp.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Paper Makers Importing Co.

Goggles
Cover, H. S.
Willson Products, Inc.

Gold
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. H. & Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Dept

Gold Decorations
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Co.
Granulators
Lancaster Iron Works, Inc.
Grinding Wheels
Carborundum Co. (*Carborundum and Aloxite*)
Chicago Vitreous Enamel Product Co.
Norton Co. (*Alundum-Crystolon*)
Hearths
Carborundum Co. (*Carbofrax* heat treating)
Corhart Refractories Co.
Electro Refractories & Alloys Corp.
Norton Co. (*Crystolon*)
Hearths (Fused Al_2O_3, SiC)
Electro Refractories & Alloys Corp.
Hearths (High Aluminous Clay, Electrically Sintered Aluminum Oxide, Silicon Carbide)
Carborundum Co.
Norton Co.
Hose (Air and Fluid)
The DeVilbiss Co.
Hydrofluoric Acid
Harshaw Chemical Co.
Iron Chromite
Harshaw Chemical Co.
Iron (Enameling)
American Rolling Mill Co.
Bethlehem Steel Co.
Iron Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Porcelain Enamel and Mfg. Co.
The Vitro Mfg. Co.
Kaolin
Ceramic Color & Chemical Mfg. Co.
Consolidated Feldspar Corp.
Edgar Brothers Co.
Edgar Plastic Kaolin Co.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Paper Makers Importing Co.
Sant, Richard C.
United Clay Mines Corp.
The Vitro Mfg. Co.
Kellog AA Refractories
Electro Refractories & Alloys Corp.
Kilns, China (Decorating)
Allied Engineering Co.
Denver Fire Clay Co.
Drakenfeld & Co., B. F.
Frazier-Simplex, Inc.
The Hommel Co., O., Inc.
Kiln Furniture (Silicon Carbide, Semi-Silicon Carbide)
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Celo Mines, Inc.
Kryolith (See Cryolite)
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Norton Co.
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Electro Refractories & Alloys Corp.
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Lehrs (Electric or Fuel Heated)
Frazier-Simplex, Inc.
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Frazier-Simplex, Inc.
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Carborundum Co.
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Corhart Refractories Co.
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
Norton Co.
Pittsburgh Plate Glass Co.
The Vitro Mfg. Co.
Lithium Carbonate
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Lithium Minerals
Foote Mineral Co.
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Electro Refractories & Alloys Corp.
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Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.
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Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept
Harshaw Chemical Co.
The Hommel Co., O., Inc.
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Harshaw Chemical Co.
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Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.
Overglaze Colors
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Oxides
Ceramic Color & Chemical Mfg. Co.
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Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.
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Ceramic Color & Chemical Mfg. Co.
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Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.
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Refractometers
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Corhart Refractories Co.
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Electro Refractories & Alloys Corp.
Kentucky-Tennessee Clay Co.
Norton Co.
Pittsburgh Plate Glass Co.
Refractory Materials
Carborundum Co.
Chicago Vitreous Enamel Product Co.
Corhart Refractories Co.
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
Kentucky-Tennessee Clay Co.
Norton Co.
Pittsburgh Plate Glass Co.
Sant, Richard C.
Titanium Alloy Mfg. Co.
Represses (Automatic)
Lancaster Iron Works, Inc.

Respirators
Chicago Vitreous Enamel Product Co.
Cover, H. S.
The DeVilbiss Co.
The Hommel Co., O., Inc.
Willson Products, Inc.

Rutile
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Foote Mineral Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Saggers
Carborundum Co.
Electro Refractories & Alloys Corp.
Norton Co.
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Salt Cake
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Sandblast Helmets
Willson Products, Inc.

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The Hommel Co., O., Inc.

Selenite of Sodium
Drakenfeld & Co., B. F.
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The Vitro Mfg. Co.

Selenium
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Drakenfeld & Co., B. F.
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Harshaw Chemical Co.
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Sheets (Enameling Iron)
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Silica (Fused)
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Silicon Carbide
Carborundum Co.
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Sillimanite Refractories
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Sillimanite (Synthetic)
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Slabs (Furnace)
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Electro Refractories & Alloys Corp.
Norton Co.
Pittsburgh Plate Glass Co.

Soda Ash
American Potash and Chemical Corp.
Ceramic Color & Chemical Mfg. Co.
Denver Fire Clay Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Pittsburgh Plate Glass Co.
Solvay Sales Corp.
The Vitro Mfg. Co.

Sodium Antimonate
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
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Harshaw Chemical Co.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
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Ceramic Color & Chemical Mfg. Co.
Denver Fire Clay Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
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Sodium Metasilicate
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Sodium Nitrite
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Sodium Uranate
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Soot Blowers
Frazier-Simplex, Inc.

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Denver Fire Clay Co.
Harshaw Chemical Co.
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Talc
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The Hommel Co., O., Inc.
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Electro Refractories & Alloys Corp.
Norton Co.

Tile (Refractory)
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Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
Norton Co.
Pittsburgh Plate Glass Co.

Tile (Wall)
Denver Fire Clay Co.

Tin Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
The Vitro Mfg. Co.

Titanium
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Titanium Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Tri Sodium Phosphate
Harshaw Chemical Co.

Trucks
Lancaster Iron Works, Inc.

Tubes (Insulating)
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McDanel Refractory Porcelain Co.
Norton Co.

Tubes (Pyrometer)
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Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
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Norton Co.
Pittsburgh Plate Glass Co.

Uranium Oxide
Harshaw Chemical Co.

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The Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Whiting
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
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Harshaw Chemical Co.
Hammill & Gillespie, Inc.
The Hommel Co., O., Inc.
Paper Makers Importing Co.
The Vitro Mfg. Co.

Winding Drums
Lancaster Iron Works, Inc.

Zinc Oxide
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc.. R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Zircon
Foote Mineral Co.

Zirconia
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
Titanium Alloy Mfg. Co.
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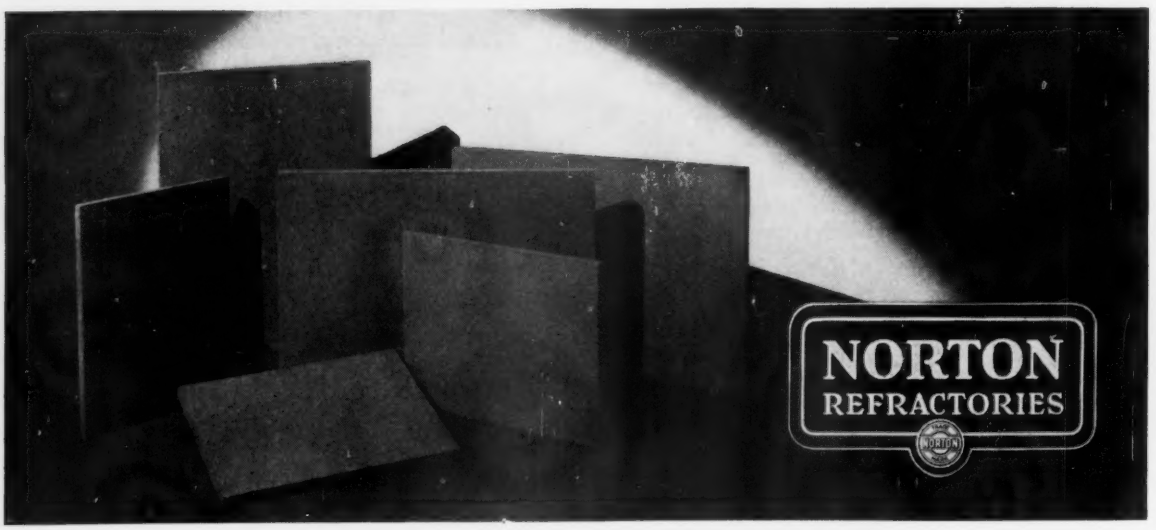

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PAPERS

GRINDING CERAMIC MATERIALS IN BALL, PEBBLE, ROD, AND TUBE MILLS*

By G. F. Metz

Abstract

Cylindrical and conical ball and pebble mills and tube and rod mills are described as well as the principle of open- *vs.* closed-circuit grinding. A list of typical grinding problems covering a number of ceramic materials and the solution of these problems are given in detail. The actual ceramic milling installations on a variety of materials are shown.

I. Introduction

In the ceramic industry like many other industries, grinding or pulverizing forms an important part of the total cost of the final product. The selection of the correct and most efficient type of grinding machinery is sometimes a problem, in view of the many varieties on the market. This paper is confined to the study of the so-called slow-speed types, *i.e.*, conical and cylindrical ball and pebble mills, tube mills, and rod mills. They employ the impact or attrition method of grinding or a combination of both.

These mills were first used for wet grinding crushed ores in the metallurgical field. Ball and tube mills have also been used for more than thirty years in the cement industry for wet and dry grinding raw materials, such as limestone and shale, prior to burning this mixture in the rotary kiln, and for dry grinding the resulting clinker. While cement materials come under the list of ceramic materials, no attempt is made here to cover the grinding in that industry.

The first type of mill to be used was the tube mill.

In its simplest form, this mill consists of a long steel cylinder supported on hollow trunnions and charged with flint pebbles (see Fig. 1). The feed enters through one trunnion and is discharged through the other; feed is introduced by a scoop or drum with internal scoop when the mill is used for wet grinding and by chute or screw feeder when dry grinding. The diameter of this type of mill varies from 3 to 8 feet and the length from 12 to 30 feet, the most popular sizes being 5 by 22 feet, 6 by 22 feet, 7 by 24 feet, and 8 by 26 feet.

The tube mill finds its greatest application where a very fine-ground product is needed and where power consumption is of no great consequence. In late years, this type of mill has been operated in closed circuit with wet and dry classifiers. The tendency in this case has been toward a shorter length of mill as it has been found that, in open-circuit grinding, 85% of the grinding is accomplished in the first 5 feet of the mill, the other 13 or 15 feet, with its heavy pebble load and high power consumption, being used to finish the remaining 15% of the material to the required fineness. Appreciation of this fact has led to shortening the tube mills and their subsequent close circuiting with wet classifiers or air separators, depending on whether they are used for wet or dry grinding. There are some materials

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which must be ground together to extreme fineness. In some cases a majority of the product must pass 10 microns. In such cases, it is usual to operate a long tube mill in open circuit. Power

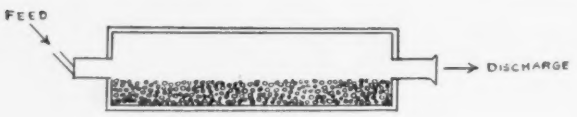

FIG. 1.

consumption is high, but the value of the resultant product usually justifies this high cost of grinding.

A later development of the tube mill is the ball-tube mill and the compartment ball-tube mill (see Fig. 2).

This mill is similar to the tube mill in all respects except that it is lined with metal liners and charged with small steel balls instead of pebbles. The compartment ball-tube mill is similar to the standard ball-tube mill, but it is equipped with one or more division heads consisting of steel grates with lifters in back of these grates. The lifters lift the product discharged from one compartment into the next. Each compartment of the mill is charged with different-sized grinding balls, thereby effecting a stage reduction of particle sizes.

The ball and pebble mills include all cylindrical or conical mills using steel balls, flint, porcelain, or quartzite pebbles. The cylindrical mill differs from the tube mill in that it has a length equal to the diameter. The conical mill has a diameter anywhere from approximately $1^1/_2$ to 3 times the length of the cylindrical section. Cones at the feed end are 60° and at the discharge end 30°. In the conical mill, a distinct classifying action of the grinding media and, to some extent, of the material being ground, takes place. Stage reduction is therefore partially effected without the use of division heads or grates. Large incoming feed is reduced by impact of the larger grinding media and these particles are reduced by successively smaller grinding media. Energy is thus expended commensurate with the work to be performed. For certain granular grinding problems, both cylindrical and conical mills are equipped with grates and lifters to effect a rapid discharge of the material. For fine grinding, the mills are operated as trunnion-overflow mills. Figure 3 illustrates the various types of ball and pebble mills. These mills lend themselves admirably to the principle of close-circuit grinding as they are capable of handling high circulating loads.

Rod mills were introduced about twenty years ago in the metallurgical field for wet-grinding ores. They have also been used for a long time in connection with the mixing and "grinding in" of sand and lime in preparation of these materials for the manufacture of sand-lime brick. They have been found more efficient for this work than the dry pans formerly used. As a result of the intimate mixing and coating of the sand grains, a stronger brick has been produced. In its simplest form, the rod mill is a cylindrical mill supported on hollow trunnions or tires with a length approximately twice the diameter (see Fig. 4).

The grinding media consists of high carbon steel rods varying in diameter from 4 to $1^1/_2$ inches, with a length equal to the length of the cylindrical section of the mill. The size of rods depends on the size of the feed to the mill and the fineness of product desired. Line rather than point contact results from rod grinding. This increases the effective grinding area per unit of steel and also reduces the tendency to produce excessive fines.

The mill is primarily a granular grinder, and its most efficient application lies in the wet or dry grinding of medium hard or soft materials from a feed size of not more than $^3/_4$ inch to a product not finer than 35-mesh and where a minimum of minus 100-mesh material is needed. It will also dry-grind damp materials which can not be handled in a ball mill unless hot air for mill drying is admitted. Rod mills can be arranged for trun-

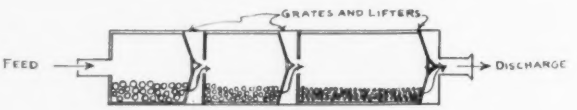

FIG. 2.

nion or peripheral discharge when used for dry grinding. Trunnion discharge is used when the mill is wet grinding. The mills are lined with wave-type manganese or chrome steel and in some cases with chilled iron liners. The consumption of rods varies from $^1/_3$ to 2 pounds per ton, depending on the amount of reduction being performed and the hardness of the material. Rod mills can be close-circuited with vibrating screens, but they will not handle as high a circulating load as a ball mill. High circulating loads tend to spread the rods apart and to reduce their crushing and grinding

efficiency. Rod mills are being successfully used for wet grinding and crushing sandstone and also for grinding hard clays containing up to 8% moisture. The power consumption is somewhat lower than for the ball mill where a granular product is desired.

All of the foregoing mills except the rod type are lined with Silex, domestic quartzite, or porcelain when they are used as pebble mills. In exceptional cases, Silex-lined mills have been charged with small cast-iron or forged-steel balls, but in most cases, where metal balls are used, the mills are lined with manganese or chrome steel or with chilled iron-wave or wedge-bar type liners. In the case of the wave-type, the plate is about 2 to $2^1/_2$ inches thick with a 3-inch thickness at the top of the wave. The conical ball mills are lined with a wedge bar and chilled iron liner. The bars project about $^3/_4$ to 1 inch above the surface of the plates and, as in the case of the wave on the wave-type liners, these bars act as lifters to the charge of grinding media. The bars are bolted to the mill shell and hold the chilled iron plates against the shell. Various other forms of lining, such as the lap type, are sometimes used in cylindrical mills.

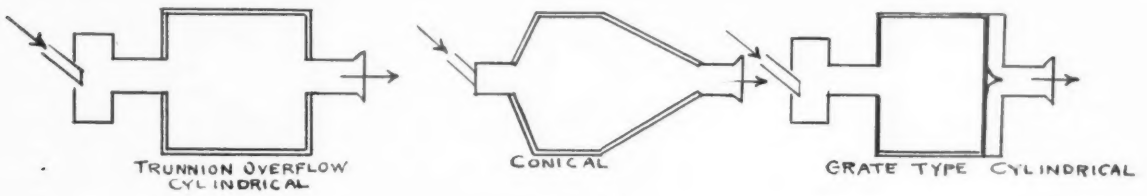

FIG. 3.

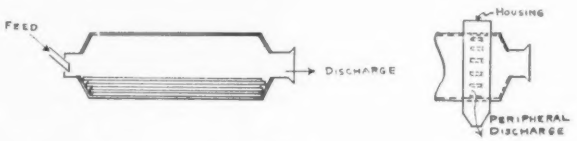

FIG. 4.

Of the four mills, the tube mill was the first continuous grinding mill to be used for the grinding of ceramic materials. Following the tube mill, the conical mill entered the field almost simultaneously with the principle of closed-circuit grinding. Most of the tube mills had been operated in open circuit. Open-circuit grinding is sometimes referred to as one-passage grinding. The pulverizer is required to finish all of the material to the desired fineness in one passage through; therefore, the amount fed to the mill must exactly equal the amount discharged. As the physical characteristics of all materials vary, the question of feed size, hardness, and moisture content must be taken into consideration, and a constant watch must be maintained in open-circuit grinding to see that uniform fineness of output is maintained.

Closed-circuit grinding is a method of reduction in which the pulverizing mill is operated in closed circuit with a classifier, either wet or dry. In this operation, the mill is not required to finish all of the material to the desired fineness in one passage. Sizing is effected by means of the classifier, the portion which is too coarse being rejected and returned to the feed end of the mill for regrinding. To illustrate, the feed to a tube mill is 5 tons per hour, which is also the amount of finished discharge. If the feed rate is doubled to 10 tons per hour, the mill product will show only 75% of finished material; after this is removed in the classifier, the net tonnage of finished material is $7^1/_2$ tons per hour, but the only additional power required is that of the elevator and air separator. In wet grinding, the amount of circulating load has sometimes reached a point where it is ten times the amount of finished product. As a result of the advantages of circulating loads, the larger diameter and shorter cylinder mills showed to advantage over the tube mill from a power consumption-per-mesh-ton standpoint. It must be borne in mind, however, that as the circulating load is increased, the product becomes more granular, even though the fineness through the limiting coarse mesh is maintained.

A good many conical and cylindrical ball and pebble mills are being operated in closed circuit with wet classifiers, vibrating screens, or air separators. In all of these operations, considerable material is finished in the first few feet of the mill and must traverse the remainder of the mill before it can be discharged and removed by the classifier. This finished material takes up valu-

able space and cushions the grinding media. To overcome this condition the air-swept principle was introduced. Figure 5 shows an arrangement of the conical mill with its superfine air

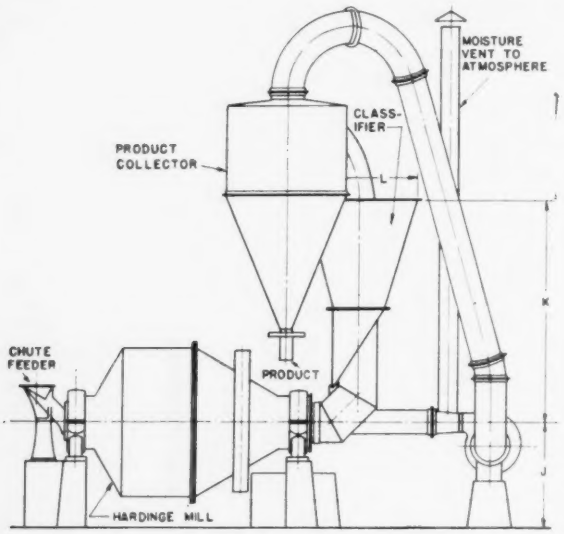

FIG. 5.

classifier. Air suction caused by a fan removes the finished material and some of the coarse from the mill as soon as it is formed.

The superfine classifier removes the coarse material from the mill product and returns it to the mill via the return air from the cyclone collector. A similar system has been employed on short cylindrical ball and pebble mills with some success. The conical mill with air classifier is a self-contained unit completely under suction. No elevators or conveyers are necessary. It has been found that with air-swept mills a material having a higher moisture content can be successfully pulverized.

Each of the foregoing mills has its field, and the following data illustrate by actual problems the proper selection and the reason for this selection. The problems are taken from actual inquiries received during the course of a year by a manufacturer of ball, pebble, rod, and tube mills.

Problem No. 1

Material: Crushed brick bats.

Size of feed: Jaw crusher product, −2-inch.

Fineness of product needed: 100% −16-mesh and uniform fines.

Moisture in feed: Less than 2%.

Iron contamination not detrimental to product: For this material, a conical ball mill using 5-, 4-, and 3-inch F. S. balls and operated in closed circuit with a vibrating screen will give excellent results at low operating cost.

Problem No. 2

Material: Silica sand.

Size of feed: −16-mesh.

Fineness of product needed: 97¼% −325-mesh with at least 50% passing 20 microns.

Moisture in feed: Less than 1%.

Product must be free from iron: For this material, a Silex-lined tube mill in closed circuit with a suitably sized air separator should be used; circulating load should be relatively low to produce maximum superfines; 3- and 2-inch flint pebbles should be used as grinding media.

Problem No. 3

Material: Ganister rock.

Size of feed: −¼-inch.

Fineness of product needed: −10-mesh with minimum amount of −100-mesh.

Moisture in feed: Less than 3%.

Slight iron contamination not detrimental to product: For this material, a peripheral discharge rod mill operated in closed circuit with a suitable vibrating screen should be used; rod charge should be made up half of 2½-inch diameter and half of 2-inch diameter; circulating load should be about 200%.

Problem No. 4

Material: Feldspar.

Size of feed: −½-inch.

Fineness of product needed: 99½-inch −200-mesh with at least 90% −325-mesh.

Moisture in feed: Less than 3%.

Product must be free from iron: For this material, a Silex-lined cylindrical or conical pebble mill with separate air separator or a conical pebble mill with superfine classifier can be used. Either mill should be lined with

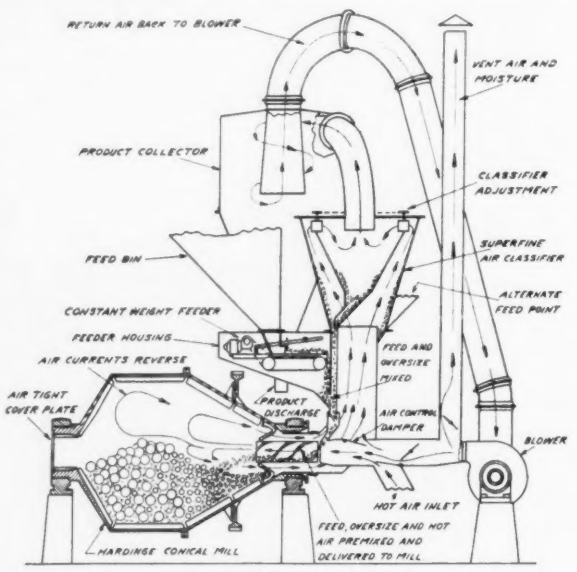

FIG. 6.

Silex lining, and No. 4 and No. 3 pebbles should be used as grinding media; the choice between these arrangements will depend upon local conditions, such as the possibility of troubles from dust or whether the mill at

times will be used for coarse grinding, in which case the user might want to operate the mill in closed circuit with a screen; the conical pebble mill can also be operated in closed circuit with separate air separator or screens

Problem No. 5

Material: Feldspar.

Size of feed: $-1/2$-inch.

Fineness of product needed: -20-mesh with less than 35% -100-mesh.

Moisture in feed: Less than 2%.

Product must be free from iron: In this case, a special conical or cylindrical Silex-lined pebble mill should be used; the mill should be of fairly large diameter and short length, and it should be equipped with a quick discharge grate to assist in the rapid removal of the ground material; the mill should be charged with No. 5 and No. 4 pebbles and should run at slightly more than normal impact crushing speed; it should be operated in closed circuit with a vibrating screen capable of handling a 400% circulating load; rapid passage of material through the mill is needed to prevent overgrinding.

Problem No. 6 (Wet Grinding)

Material: Chalk (whiting).

Size of feed: $-1\,1/2$-inch ring.

Fineness of product needed: 99.9% -200-mesh with $97\,1/2$% -325-mesh.

Moisture in feed: 10%.

Product must be free from iron: For this material, a Silex-lined long cylinder conical or cylindrical trunnion overflow pebble mill operated in closed circuit with a hydroclassifier should be used; No. 4, No. 3, and No. 2 flint pebbles should be used for grinding media; the classifier should be of liberal size and capable at least of a 300% circulating load; water should be added to the amount of 45% by weight to mill.

Problem No. 7

Material: Calcined clay (very abrasive).

Size of feed: $-3/4$-inch.

Fineness of product needed: 95% -200-mesh with impalpable fines of no consequence.

Moisture in feed: Less than 2%.

Slight iron contamination not detrimental: Undoubtedly, this problem can best be handled with a conical ball mill equipped with superfine air classifier; $2\,1/2$-, 2-, and $1\,1/4$-inch F. S. balls should be used in the initial charge.

Problem No. 8

Material: Crude soft clay with 25% fine silica.

Size of feed: 3-inch lumps and fines.

Fineness of product needed: -40-mesh.

Moisture in feed: 20%.

Product must be free from iron: In view of the fact that this clay is soft, it should first be fed to a blunger and then over a 40-mesh rotary lawn; the harder clay and

TABLE I

TOTAL POWER INCLUDES AUXILIARY EQUIPMENT USED WITH UNIT SUCH AS ELEVATORS, AIR SEPARATORS, EXHAUST FANS, AND SCREENS

Material	Size and type of mill	Capacity (tons/hr.)	Open or closed circuit	Type of classifier	Total horse power	Size of feed	Fineness of product (%)	Fineness of product (mesh)	Pebble, rod, ball load (lb.)
Silica sand (dry)	7-ft. x 22-ft. tube	3	Closed	14-ft. Sturtevant	210	-20-mesh	98	-200	42,000 pebbles
" " "	8-ft. x 84-in. conical pebble	$1\,3/4$	"	6-ft. superfine	120	-20-mesh	99	-200	18,000 pebbles
N.C. feldspar (dry)	7-ft. 6-in. x 10-ft. cylindrical pebble	1.05	"	14-ft. Gayco	85	$3/4$-in.	90	-325	
" " "	8-ft. x 48-in. conical pebble	1.25	"	6-ft. superfine	80	$3/4$-in.	99 90.5	-200 -325	10,500 pebbles
N.H. feldspar (dry)	8-ft. x 36-in. conical pebble	1.25	"	14-ft. Gayco	70	$1/2$-in.	99.5 91	-140 -325	12,500 pebbles
Canadian feldspar (dry)	8-ft. x 36-in. conical pebble	1.5	"	10-ft. Gayco	70	$1/2$-in.	97 85	-200 -325	12,000 pebbles
Enamel frit (dry)	8-ft. x 30-in. conical pebble	1.2	Open	60-mesh screen on discharge	50	$1/4$-in.	100 70	-60 -200	10,000 porcelain balls
Sandstone (wet grind)	5-ft. x 10-ft. rod	25	Closed	Hummer screen	60	-2-in.	11	-14 -100	12,000 rods
Sandstone tailings (wet)	4-ft. x 8-ft. rod	22	"	" "	45	$-3/16$-in.		-10	10,000 rods
Clay (4% moist)	5 1/2-ft. x 11-ft. rod	8	"	" "	73	-4-in.	95	-80	
Sillimanite (dry)	3-ft. x 2-ft. conical ball	$1/4$	"	2-ft. superfine	15	$-1/4$-in.	80	-100	1400 balls
Brick bats (grog)	5-ft. x 22-ft. conical ball	$4\,1/2$	"	Link-belt screen	40	$-1\,1/2$-in.	100 17	-4 -150	6000 balls
Silica sand (dry)	8-ft. x 10-ft. cylindrical pebble	$1\,1/2$	"	14-ft. Gayco	125	-20-mesh	98	-200	
Talc (3% moisture)	6-ft. x 22-ft. tube	$3/4$	Open		108	-10-mesh	94.4 82.8	-100 -200	16,000 pebbles
Talc (2% moisture)	8-ft. x 48-in. conical pebble	0.63	Closed	14-ft. Gayco	84	$-3/8$-in.	99.6	-200	14,000 pebbles
Calcined flint (hard) (wet grind)	8-ft. x 22-in. conical pebble	$1/3$	"	5-ft. bowl classifier	35	-2-in.	99.9	-200	8500 pebbles
Silica (wet grind)	8-ft. x 18-in. conical pebble	1.2	"	Bowl	33	$-1/4$-in.	100	-180	8000 pebbles
Kaolin (3% moisture)	5-ft. x 36-in. conical ball	0.63	"	4 1/2-ft. superfine	45	$-1/2$-in.	99.9 95	-200 -325	7000 balls
Kryolith (dry)	8-ft. x 60-in. conical pebble	3	"	9-ft. superfine	90	$-1/4$-in.	99.5	-150	12,500 porcelain balls
Emery (very hard) (dry)	5-ft. x 22-in. conical ball	0.43	"	6-ft. Sturtevant	35	$-1/2$-in. $+4$-mesh	65	-90 -300	7000 balls
Sodium silicate (water-glass) (dry)	6-ft. x 22-in. conical pebble	$1/3$	"	3-ft. superfine	30	$-1/4$-in.	97	-200	3300 pebbles
Fluorspar (dry)	4 1/2-ft. x 24-in. conical ball	0.6	"	4 1/2-ft. superfine	30	$-3/4$-in.	90	-325	4500 balls
Andalusite (Al_2SiO_5) (dry hardness 7.5)	6-ft. x 22-in. conical pebble	$1/3$	Open	40-mesh screen on discharge	20	-10-mesh	95 50	-100 -200	4000 pebble
Bank sand (dry)	5-ft. x 36-in. conical ball	1.2	Closed	4 1/2-ft. superfine	38	$-3/16$-in.	94.5	-200	7160 balls

silica oversize should be sent to a Silex-lined conical or cylindrical pebble mill; flint pebbles should be used for the grinding media. By attaching a cylindrical 40-mesh screen to the end of the mill, the fineness of the product can be controlled and the oversize can be returned to the mill feed by means of a bucket elevator or inclined drag conveyer; the discharge from the mill screen can be mixed with the discharge from the rotary lawn.

Problem No. 9

Material: Fluorspar.
Size of feed: −1-inch ring.
Fineness of product needed: 98% −200-mesh.
Moisture in feed: 8%.

Slight iron contamination not detrimental: For this problem, a conical ball mill equipped with superfine air classifier and using preheated air from a separate oil- or coke-fired air heater or waste heat should be used; the cost of this arrangement is lower than an installation of a separate rotary drier followed by a mill and air separator; floor space required is considerably less; air at any convenient temperature up to 900°F is admitted to the suction side of the fan and drys the material during the grinding operation; the moisture which is driven off the material is vented to the atmosphere along with the excess air; a cross-section of this unit is shown in Fig. 6.

Table I gives actual operation data on the grinding of ceramic materials in cylindrical and conical ball and pebble mills, tube mills, and rod mills.

II. Conclusions

In conclusion, the following general rules can be applied to the selection of any one of the mills discussed in this paper.

(1) Tube Mills

(*a*) For wet or dry grinding from feed sizes below 1/8-inch to produce a finished fine-ground product in one passage through mill.

(*b*) Where an excess of superfine powder is needed or where several materials are ground together requiring intimate mixing and a finished product in one passage through mill.

(*c*) For wet or dry grinding in closed circuit with wet or air classifier with low circulating load to produce very fine-ground products with maximum superfines; moisture in feed for dry grinding should not be more than 1%.

(2) Cylindrical Pebble Mills

(*a*) For wet or dry grinding in closed circuit with auxiliary wet or air classifiers to produce fine-ground products with nominal amount of superfines; feed size should not be more than 1/2 inch.

(*b*) For wet or dry coarse grinding to −4- to 10-mesh in open circuit or as fine as −35-mesh in closed circuit with vibrating screens; feed size should not be more than 1 inch except on very friable material, and the moisture content should not be more than 2% for dry grinding.

(3) Conical Pebble Mills

(*a*) For wet or dry grinding in closed circuit with auxiliary wet or air classifiers to produce fine-ground products with nominal amount of superfines; feed size should not be more than 3/4 inch.

(*b*) For dry grinding in closed circuit with vibrating screens to produce medium fine products with uniform grading down to finer meshes or with minimum fines; high circulating loads.

(*c*) When equipped with superfine air classifier for dry grinding to produce uniform fine-ground products where a self-contained unit of mill and classifier is needed, eliminating elevators or conveyers.

(*d*) With superfine air classifier where material being fed contains a small amount of moisture up to 4%.

(*e*) With superfine air classifier and mill drying with air heater, where material contains more than 4% and not over 10% moisture; feed size for air-classifier pebble mills should not be more than 1 inch.

(*f*) For wet or dry grinding to −4- to 10-mesh in open circuit or to as fine as −35-mesh in closed circuit with vibrating screens; feed size should not be more than 1 inch except on very friable material and the moisture content should not be more than 2% for dry grinding.

(4) Cylindrical Ball, Conical Ball, and Ball-Tube Mills

(*a*) The same general rules apply as under pebble mills, with or without classifiers, or conical mills, with or without superfine air classifiers, except that these mills can not be used on materials where iron contamination is detrimental to the finished product; iron contamination hardly ever exceeds 0.2% when using steel balls and lining; ball mills usually have 2 to 2 1/2 times the capacity of the equivalent-sized pebble mills; the feed size to ball mills should not be more than 1 1/2 inches and preferably 3/4 inch; ball mills will handle higher circulating loads owing to the greater weight of grinding media.

(5) Rod Mills

(*a*) For wet or dry grinding materials where slight iron contamination is not detrimental and where a uniformly graded product with minimum fines below 100-mesh is needed.

(*b*) Should not be used for grinding finer than 48-mesh.

(*c*) Feed size, unless material is very friable, should not be more than $^3/_4$ inch; larger diameter mills can handle feed up to $1^1/_2$ inch.

(*d*) For products between 16- and 48-mesh, the mill should be operated in closed circuit with vibrating screens.

(*e*) If feed is slightly damp, the mill should be of the peripheral-discharge type where the mill is dry grinding.

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PREPARATION OF COLLOIDAL MINERAL COLORS*

BY PIERCE M. TRAVIS

ABSTRACT

The preparation of mineral colors of fine particle sizes is discussed giving a new method of supergrinding by use of compressed air. A method of measuring the percentages of fines and superfines is described. The subject is presented from the colloidal viewpoint.

I. Introduction

In fine grinding and usually when the particles are broken to sizes of 5 microns or less, they again group together into clusters[1] or what are usually referred to as "agglomerates," where adsorption phenomena are quite pronounced. This, of course, is still far above the true colloidal zone which, for all practical purposes, we define as particles below 250 millimicrons. Some colloidal properties, however, are apparent on a particle size as large as 3 microns, or about 30 times larger than the true upper colloidal limit of 0.1μ. This, however, is the point where Brownian movement starts. This might be classified as a sort of "twilight zone" in which some of the colloidal properties are very pronounced, and yet it is not in the true colloidal zone. In the zone in which we are particularly interested, *i.e.*, the preparation of enamels, pigments, etc., the particle size is sufficiently large so that the wave-length of ordinary light is blocked. From here up to a particle size of 10 microns, or even larger, is what is classified as superfines. The zone of particular interest in fine grinding is where the particles are not so large that they give the appearance of a rough surface, and yet, strictly speaking, they are not in the true colloidal zone.

There are various methods of fine grinding now in use; in fact the art of grinding goes back many centuries. The present methods usually found in plants are by direct crushing mechanically, such as by roller mills, ball and pebble mills, so-called colloid mills, and various combinations, based either on the principle of crushing mechanically between rollers or balls or by hydraulic shearing. In all fine grinding to small particle sizes, the expense, of course, is after the material has been crushed below 10-mesh. Down to this point, the ordinary jaw crusher or other means may be employed with little expense. From here, however, and particularly on materials below 200-mesh, the cost in grinding increases rapidly, and the finer the material the greater the cost.

II. Shattering Particles by Impact

The method of pulverization used in preparing mineral colors and other materials is the use of compressed air and other gases to obtain high velocities in which the material is shattered. It is possible by this special means to break down various mineral pigments at an exceptionally low cost to particles around 10 microns or less. It is also possible to obtain from one to three tons per hour of this fine material at a varying cost from approximately eighty cents to $2.00 per ton. The entire unit is arranged so that it has complete automatic control and requires practically no labor, with the advantage that there is almost no wear in the unit and replacement expense is very low. It is pos-

* Presented at the Thirty-Ninth Annual Meeting, American Ceramic Society, New York, N. Y., March 23, 1937 (Materials and Equipment Division). Received March 24, 1937.

[1] (*a*) I. Fink, "Coarse and Fine Powders," *Jour. Phys. Chem.*, **21**, 32 (1917).
(*b*) T. R. Briggs, *ibid.*, **22**, 216 (1918).

sible to grind resins and other materials with low melting points, whereas in common grinding, owing to the excess heating in mechanical grindings, it is impossible to grind such resins.

Owing to the expansion of air, the material is discharged cold into the hopper, so that it is actually cold grinding and the product is broken down in a chilled atmosphere. Various colors and pigments prepared by customary methods have been broken down into finer state with a much more intense color. Prussian blue was intensified so that it did not appear to be the same material. The quantity hourly output varies with the type of material and is best explained by the data given in Section III.

TABLE I

Industrial Substances	(*G*)	(*H*)	(*T*)
Asbestos (ore)	2.5	3.5	0.98
Asphalt	1.4	2.0	0.60
Barytes	4.5	3.3	1.80
Borax	1.7	3.0	0.67
Cement (clinker)	2.9	5.0	1.00
Chalk	2.2	2.0	0.95
Coal { anthracite	1.6	1.5	0.70
Coal { bituminous	1.3	1.0	0.60
Feldspar	2.5	6.0	0.81
Glass	2.6	5.5	0.90
Granite	2.8	6.0	0.90
Gypsum	2.2	1.8	0.92
Limestone	2.6	3.0	1.02
Marble	2.7	4.0	1.00
Mica	2.8	2.8	1.10
Rocksalt	1.2	2.0	0.6
Sandstone	2.3	5.0	0.80
Silica	2.5	5.0	0.87
Argentite (silver)	7.2	2.5	2.73
Bauxite (aluminum)	2.6	6.0	0.85
Chalcopyrite (copper)	4.2	4.0	1.55
Galena (lead)	7.5	2.5	3.02
Pyrites (iron)	5.0	6.5	1.55
Quartz (gold)	2.6	7.0	0.85
Zincblende (zinc)	4.0	3.5	1.55

RELATION BETWEEN HARDNESS FACTOR AND FINISHED PRODUCT

Hardness factor (*H*)	7	6	5	4	3	2	1
Finished product (%) 300-mesh in one pass (*P*)	65	70	75	80	85	90	95

III. Properties of Material Affecting Tonnage Output

Specific gravity = G
Hardness factor = H
Tonnage factor = T
Unity tonnage factor is $T = 1$
Where $G = 2.7$, $H = 4$, and P = % 300-mesh.

$$T = \frac{G}{2.7}\left(\frac{P - 80}{80} + 1\right) = \frac{G}{2.7} \times \frac{P}{80}$$ (tonnage factor formula).

NOTES: *Re* tonnage factor. Unit capacity depends on the number of cubic feet of material which can be passed through the barrel per minute and the percentage of material reduced to the finished product (300-mesh) in one pass. Because the first factor is a constant, the tonnage depends on specific gravity of feed. The second factor depends mainly on the factors of hardness and friability. The unity tonnage factor is based on $G = 2.7$ and $H = 4.0$. The percentage of the finished product at one pass (P) is taken as 80% when $H = 4$. The tonnage factors for each material are estimated on this basis.

Actual output = Unit capacity $\times$ T (adjustment must be made in the value of T for friability; *e.g.*, for coal, chalk, rocksalt, and glass, add 50% to the value of T).

While these materials are not mineral colors, they give a good picture of the possibilities when using mineral colors. Red iron oxide in lump form was broken down by this unit into particle sizes of about 5 to 7 microns, while other material of 4-mesh size was broken down to a particle size of 10 microns and less at a capacity greater than 1 ton per hour and well within cost range. Materials that are difficult to grind, such as mica, were broken down into 10μ size.

This new method of pulverization, which is similar to exploding the material, can be accomplished at a low cost of manufacture and in tonnage output per hour varying from 1 to 5 tons.

(1) Blending

Colorings may be blended with fillers, giving the same uniform color each time and the sample taken from the top of the blended material will show the same color intensity as the sample from the bottom. In other words, it accomplishes a uniform blending on a tonnage basis.

(2) Air Classification

Among the difficulties commonly encountered in grinding is the air classification, particularly with some materials. For example, quite a few mineral substances, when broken down to particle sizes of 15 microns or less, have the tendency to agglomerate into clusters and the superfines coat the coarser particles, thereby also being rejected with this coarser material in the classifier. By the new method, the actual tonnage yield of the fine material is such that this no longer appears to be a serious problem.

The rate of feed and other adjustments may be made to bring superfine grinding below the usual cost of fine grinding. The uniform blending and other factors also make this method suitable for large tonnage operation, low cost, and simplicity.

IV. Particle-Size Measurements

We are interested in particle sizes below the 325-mesh screen or particles below the 44-micron sizes. To determine the sizes produced, various microscopical methods as well as the methods of turbidity, using the photoelectric cell, were tried,

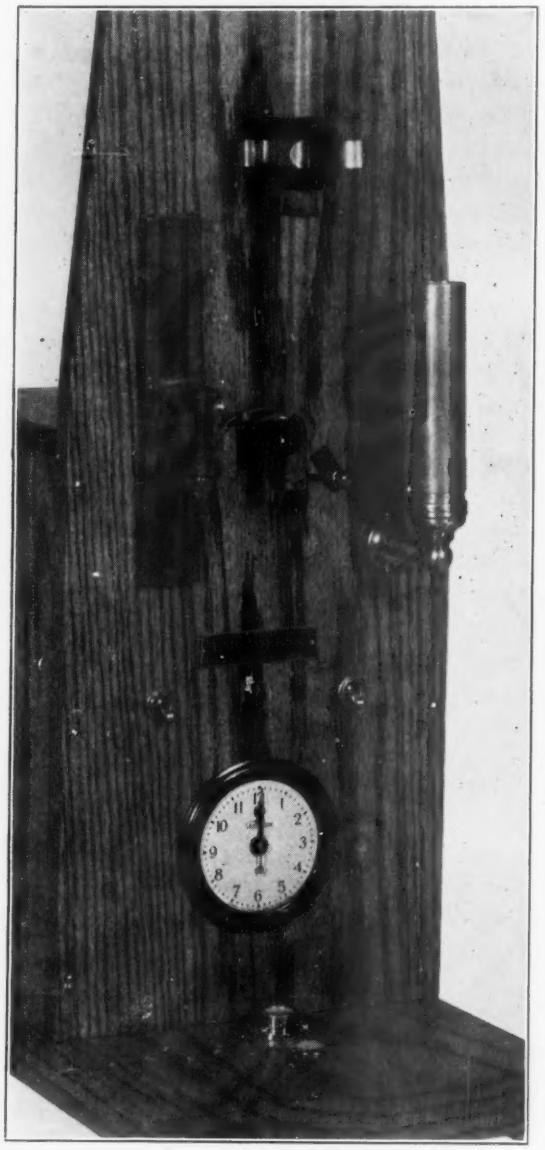

FIG. 1.

but the data were not satisfactory. A sedimentation method based on a modification of the Werner apparatus was decided upon. One was built that measured particle sizes on all materials in the zone of 44 microns down to particle sizes of about 3 microns. (Such apparatus is available through the laboratory apparatus company who coöperated in the construction of the various testing units.)

(1) Description of Apparatus

The apparatus is mounted on a specially constructed stand equipped with an electric clock which automatically times the sedimentation periods, a Verner attachment to read the amount of sedimentation in tenths of a millimeter, a graduated glass which coincides with the divisions on the sedimentation tube, and a spotlight to illuminate the point at which the reading has been made. An electric tapping device is attached for leveling the sediment in the reading tube to eliminate the personal equation as much as possible.

The sedimentation tube is arranged to give a height of fall of slightly more than one meter and is 15 millimeters in diameter of unit bore, which has attached to one end a mixing chamber of the same diameter as the tube and from 6 to 8 centimeters in length.

The mixing chamber is shut off by a special stopcock from the main settling tube. This glass stopcock has a large bore so as not to interfere with the settling of the material when it is released from the mixing chamber.

The measuring tube from which the readings are made is sealed off at the bottom at right angles to the tube itself and is supported in the bottom of the sedimentation tube by a special rubber stopper in which more than one-half of the reading tube projects beyond the sedimentation tube, giving a total height of fall of about 110 centimeters. The determination of the particle sizes is based on gravity settling.

When dispersed particles exceed the colloidal dimensions, the particles tend to settle under the force of gravity and the rate of sedimentation offers a means of measuring particle size.[2]

The gravitational force on particles in suspension in a liquid or a gas is equal to its mass times the acceleration due to gravity. If the mass particles are spherical, the mass, M, has the following value:

$$M = \frac{4}{3}\pi r^3 (d_1 - d_2)$$

$$\text{Volume of sphere} = \frac{4}{3}\pi r^3$$

Where r = radius of particle
d_1 = density of particle
d_2 = density of medium.

[2] F. E. Bartell, Laboratory Manual of Colloid and Surface Chemistry. Edwards Brothers, Inc., Ann Harbor, Mich., 1936.

For the force of gravity, G, we have the relation

$$G = \frac{4}{3}\pi r^3 (d_1 - d_2)g \qquad (G = Mg) \qquad (1)$$

Where g = acceleration due to gravity (980 dynes).

A particle falling under force of gravity through a liquid or gaseous medium encounters resistance due to bombardment by the molecules of the medium. This force of resistance is friction, F, and increases as the velocity of fall of the particle increases until it reaches its terminal velocity. This is at the point where F equals G, *i.e.*, where the particle ceases to accelerate, but continues to fall at the limiting or terminal velocity.

We apply Stokes' equation

$$F = 6\pi n r v \qquad (2)$$

Where n = viscosity of medium
r = radius of particle
v = velocity of fall.

When F becomes equal to G, we find from equations (1) and (2) that

$$Vo = \frac{\frac{2}{9} r^2 (d_1 - d_2)g}{n} \qquad (3)$$

Vo = limiting velocity of fall or rate of sedimentation.
Equation (3) may be written in the form

$$r = \sqrt{\frac{9 \cdot n\ Vo}{2\ (d_1 - d_2)g}} \qquad (4)$$

d_1, d_2, g, and n may be measured, and the radius, r, of a suspensoid particle may be calculated from equation (4).

The rate of sedimentation, Vo, is equal to the height of fall, h, divided by the time in seconds, t. Thus by equation (4), the radius of the particles can be calculated and the value of r in microns may be stated since one micron equals $^1/_{1000}$ millimeter.

Determinations can be made in distilled water for those substances which are not water-soluble. Where the material is soluble in water, it is advisable to use water-white kerosene. The material must be readily wetted by the liquid medium used and if it is not, some material must be added to increase the wetting power. For example, in materials that are not soluble in water, some of the sulfinated alcohols or some of the sulfinated compounds of the higher fatty acids may be added to the water to lower the surface tension and increase penetration. Alcohol should be used in certain cases where the material does not flocculate therein. Proper recommendations can be made according to the material used.

The sample should be well-quartered and a fair representative taken; $2^1/_2$ grams are weighed out and mixed with about 5 cubic centimeters of the liquid to be used which is worked into a paste and properly thinned to put into the top reservoir of the tube. Before doing this, however, the tube must be filled with liquid medium through which the material is to settle and the height properly measured from the release cock to the bottom of the sedimentation tube. For example, if the height happens to be 110 centimeters, this is the height of fall, and it is applied to the formula. The timing is done either by a stopwatch or by an electric clock which is attached to the apparatus, and an accurate reading tube in the bottom with the proper scaled magnifier is adjusted. The smaller reading tube is focused so that the reading glass and leveling device are properly adjusted.

In making determinations, it is necessary to determine accurately the density of the liquid and of the material when in the liquid at the laboratory temperature. This is usually about 23°C, and it is maintained at this temperature throughout the determination. Owing to the adsorbed volume of liquid about the particle, it settles similarly to a sphere when it is properly wet. The accuracy obtained by this method, due to the quantity of the sample, also has the advantage of determining in percentage.

The viscosity factor, n (specific viscosity, that is, its relation to water), is readily established by using an ordinary pipet. For example, 25 or 100 cubic centimeters are used, timing the rate for discharge of distilled water against the liquid medium which is to be used to establish specific viscosity. This is the n that is applied in the formula. The sedimentation method applies to the settling of particles under force of gravity when these are above colloidal dimensions. But in all practical work, particles down to 5 microns in size can be easily measured. Below this size, the sedimentation period takes so long that it is not desirable to use this method, but it covers all practical measurements in the zone of superfines.

The apparatus is equipped with a special release attachment so that the stopcock can be turned and the electric clock or stopwatch started at the same instant. When the first particle strikes the bottom of the sedimentation tube, this time is recorded and represents the largest particles present. Agglomeration of the particles must be avoided; otherwise false readings will be obtained as the

agglomerate settles like a larger particle. This is avoided by using special wetting agents as mentioned which must be standardized for different types of materials. The tapping attachment which levels off the particles in the reading tube should be used intermittently and stopped just about thirty seconds before a reading is made to keep the sediment leveled in the reading tube. The calculation is based upon the total amount of material in the reading tube and, from this, the various percentages on time intervals of settling are calculated after the final reading. This value represents a cross-section of the entire sample in every percentage of grading.

The apparatus is particularly suitable for work below fine-screen measurements, in which the smallest common size is 325-mesh. From this point, the apparatus is applicable down to particles of 5 microns. Several sedimentation tubes may be used at the same time, thus making particle-size determinations on several samples during the same test interval. The samples may also be run in duplicate. It is strongly recommended for routine work that curves be established to simplify the operation, so that it can be handled even by those not skilled in the art.

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THE CALCIC FELDSPAR DEPOSITS OF MINNESOTA*

By G. M. Schwartz

Abstract

The origin, distribution, composition, availability, and development of calcic feldspar, or anorthsite, of Minnesota are described.

I. Introduction

The deposits of calcic feldspar, or anorthosite, of Minnesota have been known for a long time and around 1910 attempts were made to exploit them under the misconception that the material was corundum. Although the work was a failure, much expensive equipment was installed for transporting, crushing, and screening the material.

Since 1929, a renewed interest in these deposits has been shown, owing to their possibility as a source of alumina for glass. In spite of their iron content, these are the purest large masses of feldspar known, as there is no quartz and only very small percentages of other minerals in the deposits.

Except near the highway along the shore of Lake Superior, the area is rocky and brush-covered and presents many difficulties in geologic mapping. In general, the area was mapped by running parallel traverses every quarter mile with a sun-dial compass. Actual exposures were indicated on the maps, and notes described not only the anorthosites but all associated rocks.

II. Previous Work

The anorthosites of the Minnesota coast have been known since the first geologists made observations along the coast. Irving[1] referred to them briefly in his description of the Keweenawan rocks of the Lake Superior district. Winchell[2] mentioned them in various annual reports and gave considerable detail in his final report of the Geological and Natural History Survey of Minnesota.

Lawson[3] was the first to devote a special paper to them, and his description is fairly complete for the occurrences along the coast but does not describe the great number back from the shore.

In the Twenty-Second Annual Report of the Minnesota Survey, Elftman[4] described additional occurrences farther from the shore and disagreed with Lawson as to their origin.

III. Field Relations

The large occurrences are all in Lake County, with the single exception of Carlton Peak, a very large mass near Tofte in Cook County. The

* Received August 28, 1937.

[1] R. D. Irving, "Copper-Bearing Rocks of Lake Superior," *U. S. Geol. Surv. Monograph*, No. 5, 1883.

[2] N. H. Winchell, "Geology of Minnesota," *Geol. & Nat. Hist. Surv. of Minn.*, Vol. 4, chapters 11 and 12, 1899; also Vol. 5 for petrographic descriptions.

[3] A. C. Lawson, "Anorthosites of the Minnesota Coast of Lake Superior," *Geol. & Nat. Hist. Surv. of Minn., Bull.*, No. 8, 1893.

[4] Elftman, "The Anorthosites of the Minnesota Shore of Lake Superior," *Geol. & Nat. Hist. Survey of Minn.* [22nd Ann. Rept.], pp. 174–180.

general geologic relations are well shown by Fig. 1.

The rocks which are actually found within the area where the anorthosites are known consist of an original series of lava flows and rarely thin interbedded sediments. The lava flows are predominantly basalt, but felsite flows are abundant locally. Intrusive into the lava flows are an extensive series of diabase sills, dikes, and intermediate intrusive forms. At a few places, granite or "red rock," as it is locally known, is associated with the diabases. The anorthosites are found almost exclusively in the diabase intrusives. Rare occurrences seem to be in flows, but for practical purposes these may be neglected.

The feldspar masses vary from fragments of single crystals, scattered through diabase, to large fragments or boulder-like inclusions, and finally to masses hundreds of feet in length, breadth, and thickness found throughout a large area (Fig. 2). Figures 3 to 7 illustrate various aspects of these occurrences.

In the case of the smaller occurrences, the fact that the feldspar masses are included as more or less foreign material in the diabase is evident. The boundaries between diabase and anorthosite are always sharp, never gradational.

The larger masses are so extensive that the relations to the associated diabase are not always clearly shown but, in the many examples where the relations were shown, the anorthosite invariably is inclosed in diabase with the characteristic rounded shape of the anorthosite and a perfectly

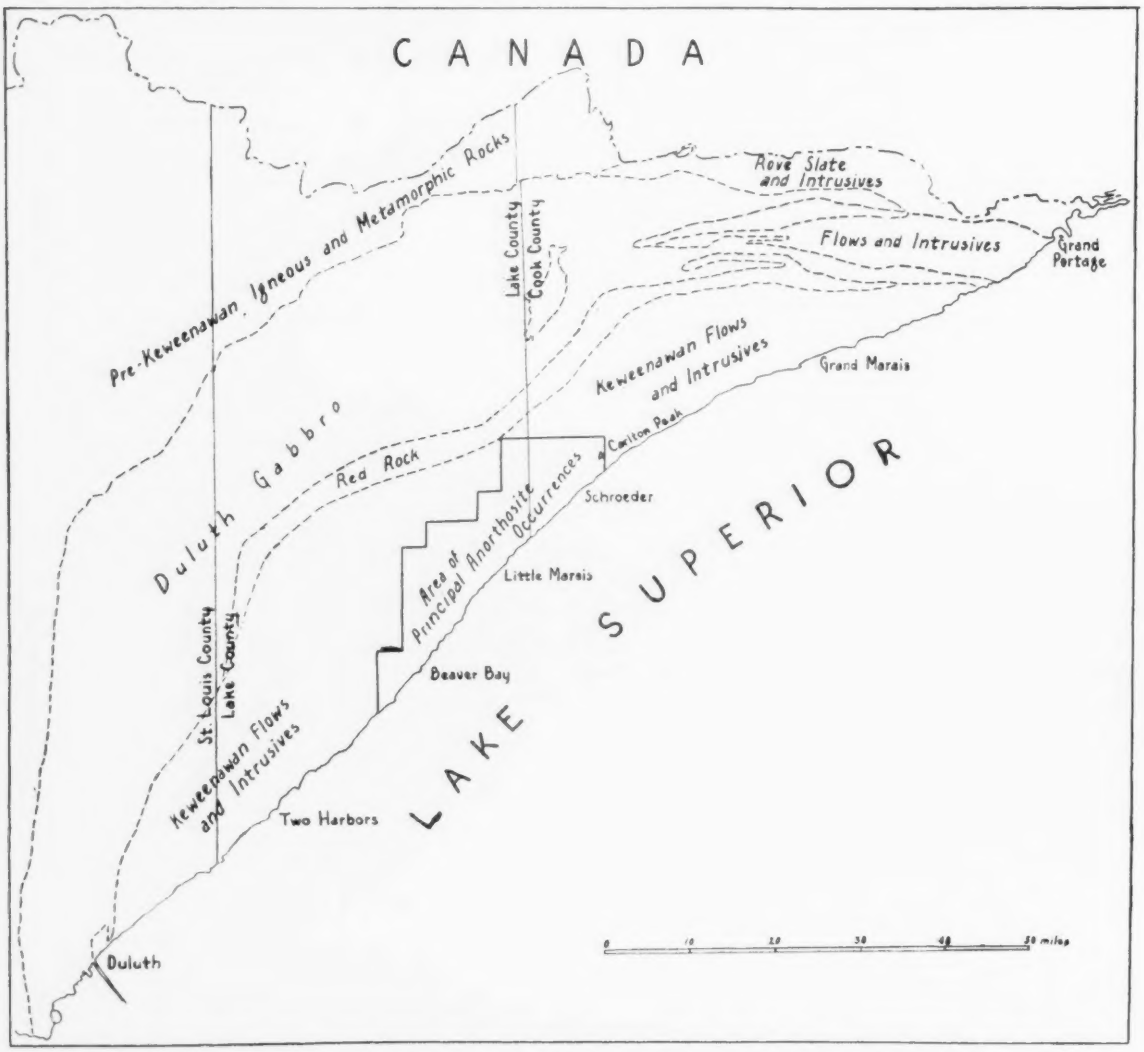


FIG. 1.—Sketch map showing location and geologic relations of the area of principal anorthosite occurrences in northern Minnesota.

sharp contact with the diabase. There is no doubt, therefore, that the feldspar masses are related to the diabase and are not to be expected except where the diabases are found. Such included masses are rare, however, or altogether lacking, over widespread masses of diabase outside of the area mapped.

IV. Petrographic Description

Several of the anorthosites were examined in thin section and found to have been extremely brecciated. It is perhaps correct to say that variations in size of grain are due much more to brecciation than to original differences in grain size resulting from crystallization.

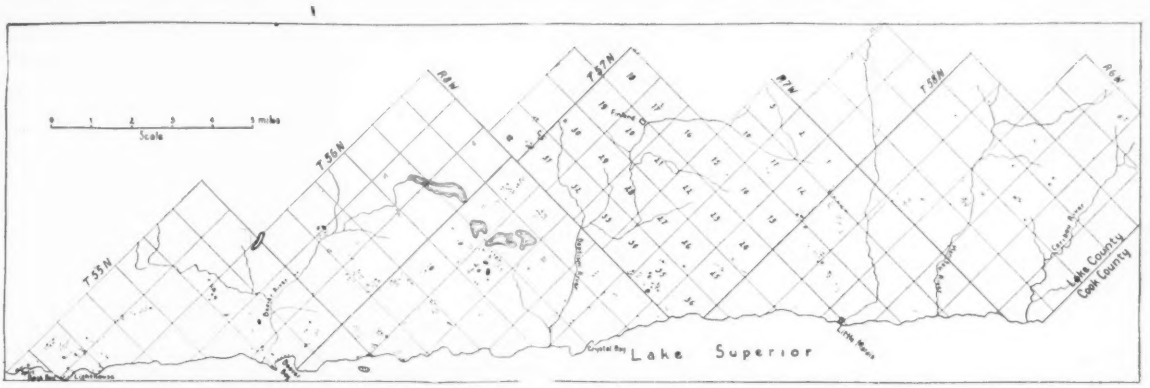


FIG. 2.—Sketch map showing the distribution of anorthosite masses in Lake County, Minn.; black dots are anorthosite.

The distribution seems entirely irregular. At places the feldspar masses are abundant over areas as large as a square mile. More frequently an area of 40 to 160 acres will have an abundance or even a predominance of exposures of anorthosite. At other places within the area, extensive exposures of diabase may reveal no masses and in the field a particular diabase may seem to contain none, but search will often reveal an isolated mass. This may be an included fragment measured in inches, or a few feet, or it may be a large mass measured in tens or hundreds of feet. Exposures that were considered large in mapping show a horizontal extent measured in hundreds of feet and a vertical extent of from one hundred feet to perhaps a maximum of three hundred feet. Vertical cliffs of 50, 100, and even nearly 200 feet of solid anorthosite are not uncommon.

FIG. 3.—Typical large anorthosite occurrence; the covered areas may be partly diabase; section 34, township 57 N., range 7 W.

The color is nearly always light gray on the exposed surface, due to a slight bleaching. This alteration normally penetrates the feldspar only a small fraction of an inch and represents the amount of weathering since glacial time. The fresh surface varies from clear, transparent to a greenish tinge or commonly a very decided brown color. One mass in Beaver Bay is practically black. Analysis of the brown rock shows a high content of ferric iron. The black has high ferrous and ferric iron and shows numerous inclusions of magnetite and pyroxene (Fig. 8).

Inclusions are commonly magnetite, pyroxene, and olivine. Olivine is nearly always affected by serpentinization and, in some thin sections, the

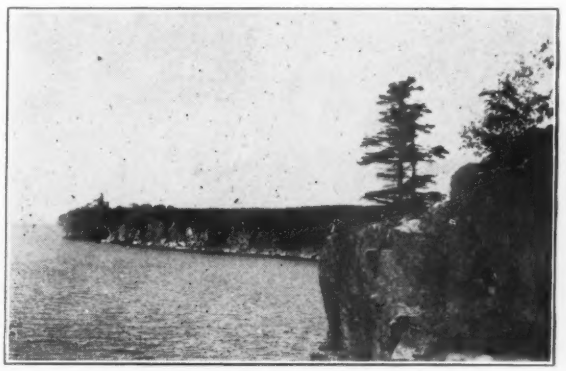


FIG. 4.—Split Rock Lighthouse on anorthosite cliff, Lake Superior; most of the rock in photograph is Beaver Bay diabase.

FIG. 5.—Typical isolated hill of anorthosite viewed from a distance; section 19, township 56 N., range 7 W.

only visible accessory mineral is secondary serpentine.

Many of the masses in the field are remarkably uniform and show no visible impurities, but many others show easily recognizable accessory minerals. One of the most common occurrences is as a series of spots, normally round or oval and about two inches in diameter. Frequently these areas have weathered out somewhat leaving a characteristic pocked surface. Examinations of these spots show a segregation of impurities in them, usually pyroxene, sometimes to the extent of showing an incipient diabasic texture. Frequently these spots are irregularly distributed throughout the mass, but in other cases they show a definite tendency to occur in zones or bands.

The more impure masses often show well-defined banding due to a variation in the amount of impurities in parallel zones.

V. Chemical Composition

The most important impurity is iron and unfortunately most of the associated minerals are iron-bearing as would be expected in a rock closely associated with, and apparently derived from, gabbro or diabase masses.

The samples analyzed were picked to show the varieties of anorthosite rather than the largest, purest masses which might develop commercial

FIG. 6.—Inclusions of various kinds of anorthosite and other rocks in diabase; southeast of Finland, Lake County.

TABLE I

ANALYSES OF ANORTHOSITES FROM THE MINNESOTA COAST OF LAKE SUPERIOR

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
SiO_2	49.78	47.40	51.45	47.25	47.97	51.54	50.68	51.45	50.59	53.01
Al_2O_3	29.37	29.74	31.94	31.56	32.45	28.87	30.67	28.47	29.88	30.04
Fe_2O_3	0.34		Tr.		0.62	1.06	0.21	0.80	0.35	
FeO	0.60	1.94		2.29		0.22	0.29	1.00	0.49	
MgO	1.07	0.57	0.27	0.27	0.16	0.39	0.42	1.07	1.18	
CaO	11.86	13.30	14.31	15.39	15.57	12.70	13.79	12.08	13.08	12.37
Na_2O	4.39	4.99	0.85	2.52	3.00	3.72	3.40	3.90	3.48	4.56
K_2O	0.46	1.56	0.21	0.37	0.53	0.27	0.09	0.33	0.12	
H_2O^+	1.76	1.64	0.68	0.40	0.38	0.82	0.50	0.63	0.79	
H_2O^-						0.08	0.03	0.18	0.22	
TiO_2	None					0.12	0.07	0.15	0.05	
P_2O_5	Tr.					0.09	0.16	0.04	0.05	
CO_2						0.03	0.03			
MnO	0.08					0.01	0.01	0.02	0.01	
Total	99.80	101.14	99.71	100.05	100.68	99.92	100.35	100.12	100.25	99.98

(1) Carlton Peak, Tofte, Cook County. *Amer. Geologist*, **26**, 281 (1900).
(2) Shore near Encampment Island, Lake County. *Geol. & Nat. Hist. Sur. of Minn., Bull.*, No. 8, p. 6 (1893).
(3) Cove east of Split Rock, Sec. 5, T. 54 N., R. 8 W., *ibid.*
(4) Boulder-like mass, coast 2 miles northeast of Beaver Bay. *U. S. Geol. Surv. Mon.*, No. 5, p. 438 (1883).
(5) Section 27, T. 56 N., R. 8 W., 3 miles northwest of Beaver Bay. R. J. Leonard and R. B. Ellestad, analysts. *Econ. Geol.*, **22**, 26 (1927).
(6) Brown anorthosite, Highway 61, Sec. 1, T. 56 N, R. 7 W. R. B. Ellestad, analyst.
(7) Split Rock quarry, Sec. 5, T. 54 N., R. 8 W. R. B. Ellestad, analyst.
(8) Black anorthosite, Beaver Bay. Sec. 12, T. 55 N., R. 8 W. T. Kamada, analyst.
(9) Very coarse anorthosite gabbro. Cove, Section 5, T. 56 N., R. 7 W. T. Kamada, analyst.
(10) Theoretical composition of labradorite (Ab_2An_3).

uses. Analyses (6), (7), and (8) were made from large samples carefully taken to give the average of a mass rather than the composition of a lump. The iron of analysis (5) has also been carefully checked by a large-scale sample from the same mass as the original large specimen which was used for experimental purposes.

VI. Origin

The origin of the masses has been a debated point since the work of Irving, Winchell, and Lawson and Elftman. The detailed mapping of the large area of occurrence of anorthosite masses with careful attention to all rock types as well as the feldspar masses has resulted in the accumulation of a great many more facts than were available to the early workers. Winchell's explanation of these deposits fits the known facts of today in many ways.

The anorthosite masses seem to be foreign material in the diabase intrusives wherever the relations are clear. The weight of evidence is that the anorthosite masses were brought into their present position as foreign inclusions floating in the diabase magma. There is only one conceivable place where such enormous masses of anorthosite could have formed and that is in the chamber which held the magma now forming the Duluth gabbro (Fig. 1). The present known exposures of the gabbro do not warrant the conclusion that the feldspar masses formed in the exposed intrusive mass of the gabbro, but rather in the chamber from which the gabbro came.

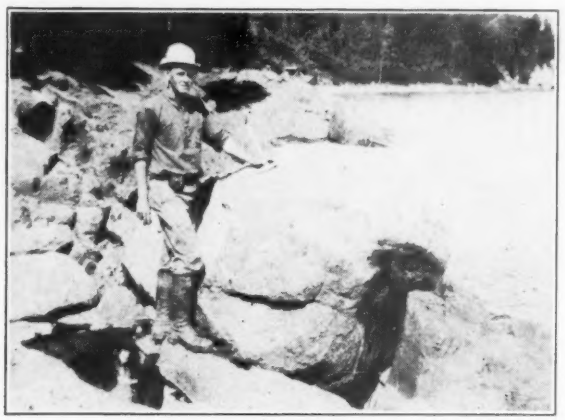


FIG. 7.—Boulder-like mass of anorthosite embedded in diabase; shore of Lake Superior, near Encampment Island, Lake Superior.

It is therefore probable that the feldspar separated from the original magma by the processes outlined by petrologists, particularly Bowen. Then tremendous intrusive activity began, which resulted in the extensive basic intrusions of the Lake Superior region, particularly in the Minnesota portion. The magma shattered the consolidated anorthosite and carried fragments along to rest eventually in their present positions with the consolidated diabase surrounding them. Their sporadic occurrence is thus accounted for.

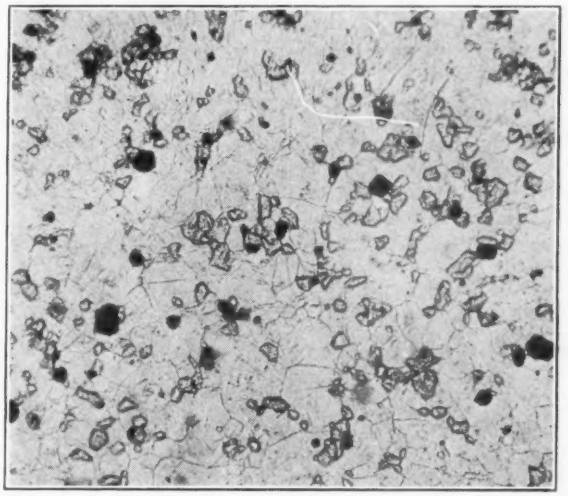


FIG. 8.—Photomicrograph of inclusions of magnetite and pyroxene in a thin section of dark anorthosite, Beaver Bay; ×75.

VII. Tests

Inasmuch as iron is the objectionable impurity, some preliminary tests were made to determine the possibility of eliminating the iron. The most feasible method seemed to be removal of the iron by magnetic means.

Large samples varying from 50 to 100 pounds were collected from three localities: (1) Split Rock quarry, coast of Lake Superior, Sec. 5, T. 54 N., R. 8 W., (2) hill on highway 3 miles northwest of Beaver Bay, Sec. 27, T. 56 N., R. 8 W., and (3) Carlton Peak, Tofte, Cook County, Minn.

The samples were composed of fragments from 2 to 4 inches across. In the laboratory, the entire sample was washed and dried, then small chips of from $^1/_2$ to 1 inch were crushed in a large diamond steel mortar to pass a 30-mesh screen. This entire sample was thoroughly mixed and quartered, and a sample was selected for iron determination. A 100-gram sample was weighed out and screened to remove the fines. The portions between 30- and 100-mesh and between

100- and 200-mesh were run through a magnetic separator, modelled after a machine described by Hallimond of England.

The tests on iron removal by magnetic means are not promising. This is due in part to the fact that olivine and pyroxene are frequently altered to serpentine and chlorite and thus lose the slight magnetic property of the primary minerals. Microscopic examination of the purest material reveals so little iron-bearing mineral that it has been suggested that some of the iron may be isomorphous either with the divalent calcium or trivalent alumina of the feldspar molecule. Empirical reasoning from the relative size of atoms suggests that it is more probable that ferric iron would be found isomorphous with alumina rather than ferrous iron with calcium.

FIG. 9.—Photomicrograph of an inclusion of olivine (*O*), in feldspar. Note inclusion of feldspar (*F*) in olivine; anorthosite, Crystal Bay quarry; ×75.

VIII. Availability

The deposits occur on the shore or within a few miles of Lake Superior. The region as a whole is unsettled, but an excellent bituminous highway follows the shore the entire length of the coast in Minnesota. A few gravelled side roads cut through the area where the anorthosites are found.

The nearest railroad is at Two Harbors nearly twenty miles from the closest deposit. Shipment of the material to obtain a low rate would necessarily be by boat on Lake Superior.

As shown, the larger deposits generally stand up as bare rounded hills which would make quarrying very simple. There is essentially no overburden, and gravity could be used to advantage in handling the quarried material.

Some of the purest masses are very large and, in the largest at least, practically 100% of the material is anorthosite. Where associated rock is encountered this is almost exclusively coarse diabase and can be readily sorted out by the contrast between the light-colored anorthosite and the black diabase.

The amount available defies calculation, but totals hundreds of millions of tons; single masses are estimated to contain as much as five million tons.

Acknowledgment

The writer is indebted to Frank F. Grout for innumerable suggestions during the course of the work which was carried out under his supervision. Professor Grout also spent the entire field seasons of 1934 and 1936 in actual mapping with the writer. The following men rendered efficient service in the field: O. H. Kristofferson, Stanley Sundeen, L. K. Lancaster, Roger Swanson, Lincoln Page, Frederick Kruger, Ben Alvarado. R. B. Ellestad kindly aided in the laboratory work and carried on the chemical work in the Laboratory for Rock Analysis at the University of Minnesota. The entire expense of this investigation was met by the Minnesota Geological Survey.

DEPARTMENT OF GEOLOGY AND MINERALOGY
UNIVERSITY OF MINNESOTA
MINNEAPOLIS, MINNESOTA

A SIMPLE HIGH-TEMPERATURE GAS BURNER*

By John J. Reimer and T. W. Drummond

Abstract

A gas burner which was made from an obsolete vacuum cleaner and pipe fittings was attached to a laboratory experimental kiln. This burner reaches cone 12 in 30 minutes and has proved to be efficient.

I. Introduction

Because of financial difficulties during recent years and a desire to obtain an efficient gas burner capable of reaching high temperatures quickly, it was found necessary to develop a gas burner at the least possible cost.

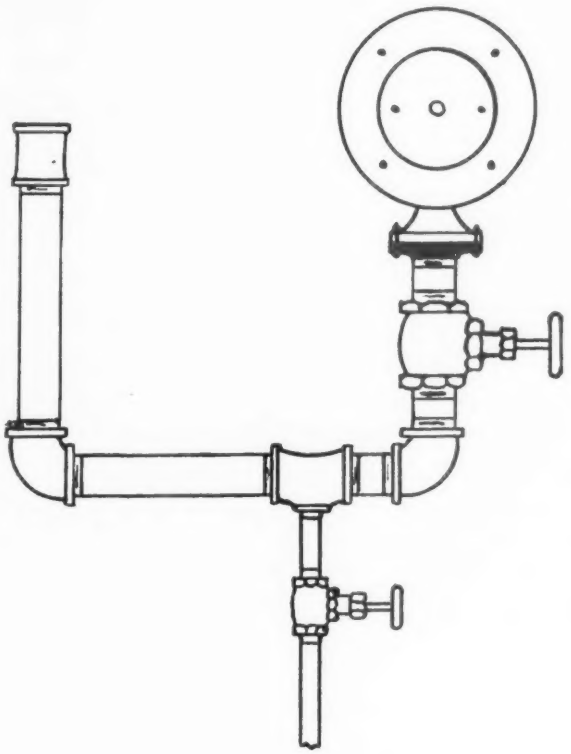


Fig. 1.—Gas burner showing gas attachment and force air supply.

(I) The Burner

To reach a temperature of 2498°F (about cone 12), it was necessary to introduce some means of force air. This was accomplished by purchasing a used obsolete Hoover vacuum cleaner for the sum of $2.00 and by attaching the motor and blower of the cleaner to the gas burner.

The burner consisted of common pipe fittings which were arranged so as to produce an accurate control of the gas and air supply.

A 2-inch valve was connected between the gas inlet and the blower, thus allowing proper control of the air supply at all times. The gas inlet, at right angles to the air supply, has a $^1/_2$-inch valve for its control.

This gas burner was attached to a small laboratory kiln with a muffle, 7 by 8 by 14 inches, which comfortably holds most laboratory trials.

II. Results

It was found that for quick firing this gas burner would reach cone 12 (about 2498°F) in thirty minutes' firing time.

On the other hand, the gas burner lends itself to a gradual increase of temperature. Cone 12 may be reached in eight hours or any other firing time that may be required.

According to the gas-meter reading, the burner is unquestionably very efficient. Two hundred cubic feet of gas were used to bring down cone 12 in a firing time of one hour. At sixty cents per thousand cubic feet, the cost of gas used would be only fifteen cents to reach a temperature of 2498°F.

From the standpoint of efficiency, practicability, and installation cost, this gas burner renders a service to all laboratory technicians.

Penn Tile Works Company
Aspers, Pennsylvania

* Presented at the Thirty-Ninth Annual Meeting, American Ceramic Society, New York, N. Y., March 23, 1937 (Structural Clay Products and Terra Cotta Divisions). Received February 5, 1937.

THE PRESIDENT'S PAGE

POLITICS

Has there ever been any politics in the American Ceramic Society?

Certainly. But before I get down to names and dates, let me ask you, in return: What do you mean by "politics"?

Join in the day's conversations, and sooner or later you will hear: "X attained his present position by politics." "Y has lost his job because of office politics." "Z is a poor administrator and no statesman at all, but he is an excellent politician." What do these statements mean, and why the slightly derogatory or disparaging flavor that we give to the word by the way we use it?

It had no such flavor for Aristotle, who wrote the first learned treatise on the subject. To Aristotle, *Politika* covered "the good of the State," as *Oikonomika* (economics) covered the good of the Family and *Ethika* the good of the Individual. While to those who are conservatively historically minded about their use of words, politics is still the art and science of doing best for the State, to ninety-nine per cent of us it connotes something that we don't quite approve of.

Let me make an attempt at a very brief description of our everyday politics:

Politics, in the popular sense, consists in the substitution of personal loyalties for institutional loyalties.

Loyalty is a real motivating influence in human conduct as contrasted with those motives that we like to assign to ourselves in explanation of our actions. Genuine and thorough-going loyalty to the State is the foundation of politics in Aristotle's sense, and is virtually non-existent. Unswerving loyalty to one's family, to a friend, or to a personal hero is incompatible with politics in Aristotle's sense, and is almost universal. Hence, politics in the nobly ambitious spirit of the founders of national loyalty, the Greeks, had necessarily to degenerate into "politics" in the opprobrious sense in which the word is used by nearly every citizen of the world's largest republic.

In spite of the almost insuperable difficulties in the way of being consistently loyal to a human institution, we know it can be done. No one who has become personally acquainted with a member of the Society of Jesus can doubt the permanent power and the deep satisfaction of the Jesuit's loyalty to his organization, transcending all personal ties and interests; and you may make what allowance you please for the fact that he has been selected for strength of character as much as for piety. Is there any good reason why a scientific or technical organization should not receive equal loyalty? It may seem a far cry from the austerities of a religious order to the free-and-easy ways of the American Ceramic Society, but both types of organization hark back to the same impulse: the voluntary association of people who have similar ways of thinking and similar purposes. So when our councils are confused by considerations of selfishness, personal loyalty, personal prejudice, or business interest, I appeal to every member to consider first the permanent good of the Society, and to let no personal disappointment shake his loyalty to its concerns.

There is one aspect of loyalty to the Society that deserves another paragraph—but this editorial is becoming too ponderous, so I will finish with a story, one of Dr. W. P. White's favorites:

A rising young man had been invited to dinner at his employer's home. His family all gathered about him on his return later that evening, eager to hear his experiences and observations.

"We started off with some odds and ends and then they brought on some soup. I was so busy tryin' to be nice to the hostess that I didn't notice until I got it into my mouth that there was somethin' in the soup that shouldn't 'a' been there. I didn't dare take it out to look at it, so I just wallered it 'round and wallered it 'round—

"And then they brought on some fish. What with the fish-bones, I had an awful time with that thing in my mouth. It seemed kind o' smooth on one side and fuzzy on the other, but I kept wallerin' it 'round and wallerin' it 'round—

"And then they brought on some good roast chicken and fixin's. While I was gettin' 'em down I thought I could count four legs on the thing, but mebbe two had got broken off, but anyway I kept wallerin' it 'round and wallerin' it 'round—

"And then came some salad. I thought by this time I could feel some feelers on the thing, but I kept wallerin' it 'round and wallerin' it 'round—

"And then came some awful good ice-cream, and here I was still wallerin' it 'round and wallerin' it 'round—"

Sister, bursting with curiosity and impatience, could stand it no longer. "What in the world was it?" she cried.

"I dunno. I swallered it for the honor o' the family."

—ROBERT B. SOSMAN

New Members joining during December 1937, will receive the December Index Issues for 1937 as well as all 1938 publications

Plan to Attend the Annual Meeting
New Orleans, La.
March 27–April 2, 1937

ACTIVITIES OF THE SOCIETY

REPORT OF THE FELLOWSHIP COMMITTEE ON EDUCATION AND PUBLICATION, 1936–1937

This Committee was authorized to encourage the publication of texts, bibliographies, etc. It gives us pleasure to report that we have assisted in securing the publication of the "Bibliography of Ceramic Microscopy" which was issued as the February number of the *Bulletin*. We have been advised that work on the revision and expansion of the "Phase-Rule Diagrams" is progressing satisfactorily under the direction of Louis Navias, Chairman of the Committee on Research, and F. P. Hall, Chairman of the Committee on Data. In due time, this material should be presented through this Committee to the Trustees of the Society for publication as provided by the resolution adopted last year. We wish to remind the Fellowship that last year action was taken by them providing that a publication subsidized by this organization be designated a Fellowship publication. It was and is our understanding that the intent of that action was to provide for the printing of such a title or announcement on the cover of all publications so issued.

The Fellowship at its previous Annual Meeting voted to approve the expenditure of $1000 for assisting in publication of approved material and $800 for the Phase-Rule publication. According to estimates kindly furnished by Secretary Purdy in February, the expenses of publication to be defrayed by material in hand were as follows:

McCaughey–Orton Memorial Lecture	$224.87
McVay Bibliography	320.00
Total	$544.87

It was anticipated that a considerable sum would be expended for the Phase-Rule material, but we have no estimate as yet.

It will be seen that the total amount set aside for publications apparently has not been expended. It is recommended that an additional appropriation be made next year for these purposes.

Attention of the Fellowship is directed to the recommendations[1] of the Committee on Ceramic Education of the Society as follows: "The following recommendations were adopted. . . ." The recommendations provide that a Committee on Education of the American Ceramic Society of five members be appointed and provision was made for subcommittees. This eliminated the previous Division set-up. Because of this action, it is our opinion that further consideration of the subject of undergraduate training be held in abeyance until the policies of the Subcommittee and the Committee on Education of the Society are formulated.

Constant attention has been given to the study and improvement of undergraduate curricula in ceramic engineering since the first course of study was offered at Ohio State University in 1894. During the past few years, there has been increased activity in the study of the curricula offered at the several schools, not necessarily for the purpose of standardization, but as a basis for further improvement. As you know, a Committee of the Association of Ceramic Educators and Committees on Education of the Society and of the Fellows have played an important part in this movement. More recently, the Society for the Promotion of Engineering Education and other organizations have undertaken the formal rating of the various departments of the engineering schools of the country through the agency of the Engineering Council for Professional Development. This movement is of especial interest to us because an effort is being made by the parent Society to have ceramic engineering recognized as a major branch of the engineering profession. The successful outcome, we hope, will enable graduates with suitable qualifications to be licensed as Ceramic Engineers in those states where that practice is established by law.

These activities have been concerned almost entirely with the status of the undergraduate student and the four-year graduate, without giving much attention to the problem of specialized training which must come in post-graduate study. In order to introduce the subject of graduate study for discussion, a brief survey of the requirements for graduate degrees in Ceramic Engineering in the following schools has been made. The information has been obtained from graduate catalogues and in some instances from questionnaires. The survey included the following schools: Iowa State College, New York State College of Ceramics, North Carolina State College, Massachusetts Institute of Technology, Ohio State University, Pennsylvania State College, Rolla School of Mines, Rutgers University, Virginia Polytechnic Institute, University of Illinois, University of Toronto, and the University of Washington.

Graduate work in ceramic enginering is offered by all of the schools listed, leading to the degree of Master of Science. The Massachusetts Institute of Technology, Ohio State University, Rutgers University, Pennsylvania State College, and the University of Illinois offer work leading to the degree of Doctor of Philosophy in Engineering. This seems to be the customary degree. The degree of Doctor of Science is an alternative in one institution but is usually an honorary degree.

The residence requirements are quite generally one year for the Master of Science degree and three years for the degree of Doctor of Philosophy. Actual differences exist, however, because of the variation in the credit allowed toward a degree for work done as part of the contract of staff appointees and holders of fellowships. On such a basis, the actual time required to obtain a Master of Science degree varies from two and one-third years to eight years for full-time appointees, from one and one-third to two years for half-time appointees, and from one to one and

[1] See *Bull. Amer. Ceram. Soc.*, **16** [3] 115 (right-hand column) (1937).

one-half years for quarter-time appointees. These differences occur because of the variations in the amount of academic work the student is permitted to carry when on appointment and the amount of credit allowed for work done as part of the student's fellowship contract if counted as thesis.

The actual time required to obtain the degree of Doctor of Philosophy varies from 6 to 12 years for full-time appointees and from 3 to 8 years for half-time appointees. The reason for the differences in time required to obtain a degree are, in general, the same as those which apply to the Master of Science degree.

Naturally, the time spent in pursuit of graduate study is not the basis for judging the quality of the work. No doubt the restrictions with respect to residence credit are made to protect the contract and prevent neglect of duties as well as to provide ample time for the student to carry out his graduate study properly.

The application of work done on appointment toward credit for a degree also causes a variation in the time required to obtain a degree. It is conceivable that such work might not be of strictly graduate character, for some investigations obviously might be of routine character. In some cases the practice varies, (1) work done on appointment can not be used for credit toward a degree; (2) the work may be used for credit, subject to the approval of the department; (3) no apparent restrictions are made and the work done on appointment is counted as thesis. In the latter case, no doubt care is exercised in the selection of problems, but such work usually is carried out under rather close supervision which would be contrary to the usual conception of graduate work in which the student is required to demonstrate power of independent research.

In addition to the residence requirements for the student, the academic training and experience of the departmental staff and its qualification to conduct graduate work are of great importance. Furthermore, strong supporting departments in the minor subjects are essential to the complete success of graduate work in any individual institution.

Information concerning the training and qualifications of staff members in the several schools is not available at the present time, nor is adequate information concerning the supporting departments. In general, chemistry, physics, geology, mineralogy, and petrography are the minor subjects most frequently chosen, while mathematics, photomicrography, fuels, metallurgy, and metallography occasionally are studied.

In the department of the major subject, courses frequently are listed as "seminar," "ceramic technology," or "research," and the actual content of the course is adjusted to fit the needs of the individual student. The subjects include both fundamental studies and more or less practical studies of raw materials and manufactured products. Some of the subjects which have been given in the past are enamels, glazes, driers, heat transfer, decoration, heat treatment of ceramic materials, viscosity diffusion, surface tension, colloids, the glassy state, properties of solids and glasses at low and at high temperatures, optical and X-ray data on ceramic solids, firing, heat balance of driers and kilns, occurrence and beneficiation of kaolins, fire clays, diatomite, chalk, mineral pigments, quartz, mica, talc, soapstone, chromite, Portland cement, glass, etc.

Obviously, it is difficult to know from the title whether the course content or research problem is of strictly graduate character, because the actual value of the work will depend upon the qualifications of the instructors and the actual treatment of the subjects in the case of classwork, the departmental standards, and the ability of the student in the case of research. Adequate equipment is an important factor in graduate work.

In order to judge graduate work properly in ceramic engineering, we need more complete information concerning the qualifications of the teaching staffs, the actual content of the graduate courses offered, the character of the work done on appointment and counted as credit toward graduate degrees, and the strength of the supporting departments in the minor subjects. This seems to be a worth-while project for future committee study.

—Committee on Education and Publication: C. W. Parmelee, *Chairman;* C. E. Bales, A. V. Bleininger, A. F. Greaves-Walker, F. A. Harvey, A. V. Henry, M. E. Holmes, T. N. McVay, A. S. Watts.

WHY NOT WEAR THE SOCIETY KEY?

FORTIETH ANNUAL MEETING, NEW ORLEANS, MARCH 27-APRIL 2, 1938

A local committee in New Orleans has arranged a schedule of events that will be different and appealing.

Programs of technical papers are shaping up. There are already 98 papers and addresses pledged, and others under contemplation. Forty-six more papers are needed to fill the schedule.

Our members, individually, should consider this their opportunity and their obligation. You are expected to make program contributions. It is not healthy to be forever and only on the receiving end in this coöperative effort to extend ceramic knowledge.

Please send in the title of the paper you will present.

Geological Surveys of the states south have planned exhibits. In addition, there will be four ceramic exhibits of ceramic products, one of them the National Ceramic Exhibit.

This 40th Annual Meeting has already the substance and form of a very valuable occasion.

Division Program Chairmen

The Division Program Chairmen to whom you should send the title of the paper you will present are as follows:

Art, L. E. Barringer, General Electric Co., Schenectady N. Y.

Enamel, G. H. Spencer-Strong, Porcelain Enamel & Mfg. Co., Baltimore, Md.

Glass, L. C. Roche, Maryland Glass Corporation, Baltimore, Md.

Materials and Equipment, H. B. DuBois, Consolidated Feldspar Corporation, Trenton, N. J.

Refractories, J. B. Austin, U. S. Steel Corp., Research Laboratory, Lincoln Highway, Kearny, N. J.

Structural Clay Products, W. H. Vaughan, Georgia School of Technology, Atlanta, Ga.

Terra Cotta, H. E. Davis, Federal Seaboard Terra Cotta Corp., South Amboy, N. J.

White Wares, Karl Schwartzwalder, AC Spark Plug Co., Flint, Mich.

WOMEN'S TENTATIVE PROGRAM

Sunday, March 27

Morning
Lunch
Afternoon
Dinner
Evening: Gail Jubilee Singers, Roosevelt Hotel

Monday, March 28

Morning: Tour through uptown section of city
Lunch: Tulane University
Afternoon: General meeting of the Middle American Research; Mr. Blom's lecture, Newcomb Art School; Sixth National Ceramic Exhibit
Dinner
Evening: Tulane Glee Club concert

Tuesday, March 29

Morning: Vieux Carré or sightseeing. (Sightseeing tour usually in two sections, as New Orleans covers a great deal of territory.)
Lunch: Louisiane Restaurant. (A special rate if 30 or more sign for lunch.)
Afternoon: Tour of Vieux Carré or sightseeing.
Dinner
Evening: Orton Lecture at Roosevelt Hotel

Wednesday, March 30

Morning: Huey P. Long Bridge or sightseeing bus or Kingsley House Settlement Potteries
Lunch
Afternoon
Dinner
Evening: Delgado Museum reception and exhibition from Louisiana State University (Indian Potteries)

Thursday, March 31

Morning: Tour of docks or boat ride to see levees
Lunch: Courtyard Kitchen. (A special rate if 30 or more sign for lunch.)
Afternoon: Exhibit and refreshments at the Green Shutter, No. 633 Royal St., from 2:00 to 7:00 P.M.
Dinner
Evening: Little Theatre

Friday, April 1

All-Day Trips as Follows:
Anderson Potteries, visit to Ocean Springs, Miss., with picnic lunch. (Leave at 9:00 A.M. and return about 6:00 P. M.) or
Salt Mines. (Leave New Orleans at 4:00 A.M. and return at about 6:00 P.M.) or
Bayou Liberty. (Leave at 10:00 A.M. and return to New Orleans at about 5:00 P.M.) with picnic lunch and visit to St. Joe Brick Co. or row down the Bauou.
Dinner: Antoine's. (A special rate if 30 or more sign for dinner.)

GREETINGS FROM SOCIETY OF GLASS TECHNOLOGY

President, officers, and members of the Society of Glass Technology in session at the 21st Anniversary Meeting send hearty greetings and reciprocate your wishes for continued close working between our two Societies.

—M. PARKIN

UNIVERSITY OF ILLINOIS—STUDENT BRANCH OF THE AMERICAN CERAMIC SOCIETY

The University of Illinois Student Branch of the American Ceramic Society has completed plans for the present school year and is now actively engaged in the promotion of the following activities:

(1) Bimonthly meetings with interesting speeches by students, faculty members, and prominent men in the ceramic field; (2) weekly issue of a bulletin entitled, *Raw Materials*, which contains entertaining information about students and faculty; (3) sponsorship of a ceramic yearbook entitled, Illini Ceramist, which is comparable to the school yearbook but on a smaller scale; (4) promotion of the second annual "Ceramic Ruckus," a major school dance for ceramic students and faculty; (5) participation in various intramural athletic games, with "all-ceramic"

teams; (6) sponsorship of the annual "Pig Roast," a final meeting and banquet in honor of the graduating seniors.

The Student Branch, with a record membership of 98 this year, is directed by student officers, with the aid of an executive board of prominent members and a faculty adviser. By virtue of the above activities, most of which were pioneered in the last year, the Branch has taken a prominent place in student organizations and is now recognized as the leading engineering society on the campus.

Probably the most interesting sidelight of these activities concerns the program for the "Ceramic Ruckus." Last year the programs, made of copper, had a black-and-white enameled dancing couple on the cover. These were planned and completely made by Branch members. Similar programs for this year will present a new orange-and-blue enameled design on thin gage steel.

Speakers who have tentatively agreed to appear at meetings this year include such prominent men as follows:

R. B. Sosman, President of American Ceramic Society, U. S. Steel Corp., Research Laboratory, Kearny, New Jersey; Hugo Filippi, Illinois Brick Co., Chicago, Ill.; R. R. Shively, B. F. Drakenfeld & Co., Washington, Pa.; R. S. Bradley, A. P. Green Fire Brick Co., Mexico, Mo.; C. H. Henderson, Alton Brick Co., Alton, Ill.; V. W. Boeker, Richards Brick Co., Edwardsville, Ill.

CHICAGO SECTION

On Friday, January 21, 1938, Alexander Silverman of Pittsburgh University will address a joint meeting of the Chicago Sections of the American Ceramic Society and the American Chemical Society on the subject, "Recent Developments in Glass."

The meeting will start with a dinner at 6:30 P.M., at the Stevens Hotel. Tickets may be obtained from the secretary of the Chicago Section of the American Ceramic Society. This talk should be of great interest to all who are acquainted with glass.

—REXFORD NEWCOMB, JR., *Secretary*

OHIO STATE UNIVERSITY STUDENT BRANCH

The regular monthly meeting of the Ohio State University Student Branch of the American Ceramic Society was held Tuesday evening, November 23, 1937, in Lord Hall. John Younger, Chairman of the Department of Industrial Engineering, spoke on "A Wage Incentive System."

Sophomore ceramic engineers were especially urged to attend.

—JAMES WILLIS, *Secretary*

NORTH CAROLINA STATE COLLEGE STUDENT BRANCH

The North Carolina Student Branch of the American Ceramic Society held its first meeting of the academic year on October 5 with thirty members in attendance. The program presented was the first of a series which has been designed to interest the other students on the campus, as well as those in ceramic engineering, and will continue throughout the year.

The chapter listened to an address by Dean Blake R. Van Leer, the former Dean of Engineering at the University of Florida and originator of the "Five-Year Plan of Engineering Education." Dr. Van Leer, now Dean of Engineering at the Raleigh unit of the University of North Carolina, spoke on a subject of vital importance to all the engineering students, "The Future of Our Engineering School."

Dr. Van Leer suggested that the students do everything possible to promote the interests of their department, for it is largely through the efforts of the students that an institution makes progress. "The productive student," according to the Dean, "should not accept all the statements printed in textbooks or voiced by instructors as 'gospel,' but he should put all such material to a crucial test—the real engineer must have initative. Every potential engineer should realize that college affords him an opportunity to exercise his engineering skill and ability in designing and constructing (or even inventing) equipment he requires in the laboratories and classrooms."

Dr. Van Leer complimented and congratulated A. F. Greaves-Walker and the Department of Ceramic Engineering on the recognition of ceramic engineering by the Engineers Council for Professional Development and the accrediting of the department, stating that it is the only department in the South to be so accredited and one of five in the entire country. This official recognition gives it a prominent position as one of the outstanding departments in the United States. He also stated that it has made a record of research and training of capable ceramic engineers that has gained for it recognition from coast to coast.

Plans are being made to prepare exhibits for the annual Engineer's Fair which will be held in April. The Branch also unanimously voted to contribute annually to a student loan fund which was started last year by the North Carolina Chapter of Keramos. This fund will be available to seniors in the department who are in need of financial aid.

WHAT TO EXPECT TO FIND WHEN YOU GO TO THE FORTIETH ANNUAL MEETING IN NEW ORLEANS, MARCH 27–APRIL 2

The South's largest city, with a population of more than 500,000.

The port of the Mississippi Valley to the world and second U. S. Customs district in value of foreign commerce.

The South's leading wholesale, retail, industrial, and financial center.

The fourth largest city in the country in area.

The atmosphere of old France and old Spain in its Vieux Carré with its narrow streets, peculiar architecture, iron-trellised balconies, myriad-shaped roofs and chimneys, fan windows, lovely patios.

Ante-bellum homes in the Garden District; plantation homes along Bayou St. John and elsewhere.

An inner-harbor navigation canal, connecting the Mississippi River with Lake Pontchartrain, built at a cost of $19,500,000.

The Mississippi River's finest bridge, the $13,000,000 Huey P. Long Bridge.

The world's finest airport, Shushan Airport on Lake Pontchartrain.

The flood-control engineering feat of the century, Bonnet Carré Spillway, a product of U. S. Army engineers.

Two thousand acres of land reclaimed from Lake Pontchartrain, now lined with a beautiful scenic highway and now being developed into an outstanding waterfront playground.

A water-purification plant where the muddy water of the Mississippi is made pure and crystal clear.

The world's greatest drainage system with the largest pumps in existence.

The world's largest ship-side cotton warehouse, covering 33 acres of covered warehouse space.

The country's finest coffee terminal.

Fourteen unique automatic pocket conveyers for unloading bananas from ships at the rate of 2500 bunches an hour each.

A public bulk vegetable oil pumping plant, capable of loading 16 tank cars at one time.

A public grain elevator with storage capacity of 2,600,000 bushels.

A public coal and bulk commodity handling plant which can handle coal ores, sulfur, etc., direct from cars to storage or vessels or from storage to vessel at the rate of 400 tons per hour.

Ocean-going ships loading petroleum, lumber, cotton, iron and steel, paper, lard, tobacco, carbon black, molasses, rosin, salt, chemicals, and other commodities for world ports.

Ocean-going ships bringing into the port from world ports sugar, molasses, petroleum, bananas, bauxite, coffee, sodium nitrate, creosote oil, jute, vegetable oils, logs, sisal, paper, chemicals, and other products.

A port comprising 52 miles on the Mississippi River and the Inner Harbor Navigation Canal.

River and harbor improvements valued today at more than $200,000,000.

Nearly eight miles of wharves and five and one-half miles of steel and concrete transit sheds.

A public belt railroad with 95 miles of tracks.

Nine railroad lines serving the nation.

Seventy-two steamship lines with frequent and regular service to world ports.

The terminus for 13,000 miles of inland waterways.

Barge lines that operate to points on the Mississippi and tributaries, the Warrior River and through the Intracoastal Canal.

A city with more than 170 universities, colleges, schools, and convents.

A municipal auditorium with a seating capacity of 10,000.

Eighteen hospitals with modern facilities.

Under construction, the new Charity Hospital, costing $12,000,000.

The old home of Dr. Antomarchi, maker of the Napoleon death mask.

The cast of the Napoleon death mask.

The birthplace of E. H. Sothern, distinguished actor.

The home of Paul Morphy, world-famous chess champion.

The birthplace of Robert Edeson, actor of note.

The residence of Adelina Patti, golden-voiced singer.

Madame John's Legacy, oldest building in the Mississippi Valley.

Beauregard Square, former favorite gathering place of slaves and scene of weird voodoo ceremonials.

The old Ursuline Convent, erected in 1734.

The French Market, originally erected in 1791 and reconstructed in 1937.

The Cabildo, where the greatest real estate deal in history took place when the entire Louisiana Territory, now all or part of 17 states, was bought from France for about four cents an acre.

The Pontalba buildings, America's first apartment houses.

The St. Louis Cathedral, built in 1794 and still in use.

The United States Customhouse, the cornerstone for which was laid by Henry Clay in 1847.

Sewerage, water, and drainage facilities valued at $70,000,000.

A city with bank debits valued at $2,500,000,000; bank deposits amounting to $254,000,000; automobile registrations of more than 79,000; telephones in excess of 74,500.

One of the five great medical centers in the world.

Two hundred and sixty miles of street-car, bus, and trolley bus routes.

Headquarters for the American Cotton Coöperative Association, Southern Hardwood Lumber Producers, Southern Pine Association, American Sugar Cane League, and Rice Millers Association.

Home of the cottonseed products industry and the celotex industry, and the men's summer suit industry.

The birthplace of French Opera in America.

The birthplace of the Mississippi Valley Association.

Fully stocked hunting and fishing grounds within the city limits.

A city park, covering 1800 acres.

Tulane and Loyola Universities, and Louisiana State University Medical Center; Newcomb College for Girls; Dillard University and Xavier University for negroes.

The center of the greatest fur-producing area in the United States.

One of the oldest girls' schools in the United States, Ursuline Convent.

Members of the American Ceramic Society attending the Meeting in New Orleans will find peculiar interest in the Louisiana Department of Conservation Museum.

This Museum, the first state-owned conservation museum in this country, presents an orderly, well-labeled, and carefully prepared exhibit showing all of the various natural resources of the State.

An especially attractive feature to the public is the free motion-picture service and lecture which in a short time gives a wealth of knowledge about the State's resources.

The Museum is located at 239 Royal Street, within walking distance of all hotels. Admission free.

NEW MEMBERS

Corporation

CHATTANOOGA GLASS CO., R. T. Settles (voter), Chattanooga, Tenn.

Personal

DALTON, JOHN P., 21 W. 10th St., Suite 1000, Kansas City, Mo.; consultant.

DENNY, KATHERINE E., 1407 E. 45th St., Seattle, Wash.; student instructor, University of Washington.

FOURL, CHARLES W., 514 N. Orange Grove Ave., Los Angeles, Calif.; owner, Padre Potteries.

FRANKEL, H. D., JR., 2539 Broadway, Indianapolis, Ind.; ceramic engineer, Chicago Fire Brick Co.

GITZEN, WALTER H., 1 Wesley Drive, Belleville, Ill.; research associate, Aluminum Co. of America.

*MONCRIEFF, J. W., 680 Sanchez St., San Francisco, Calif.; engineer, Owens-Illinois Pacific Coast Co.

PARRY, WILLIAM, Beltrees, Linwood Rd., Paisley, Scotland; technical manager, Clay Industries, Ltd.

PUTNEY, MRS. EDMONDS, 125 E. 63rd St., New York, N. Y.

WILCOX, HERMAN G., 332 W. Lehigh Ave., Homestead, Pa.; Harbison-Walker Refractories Co.

WILLSON, WILBUR W., Frick-Reid Supply Corp., Pittsburgh, Pa.; material handling engineer.

Student

ALMY, THOMAS M., N. Y. State College of Ceramics.

DORAN, ROBERT, Pennsylvania State College.

ELLIS, JAMES L., University of Saskatchewan.

GORMLY, MAURICE W., Iowa State College.

HALL, JAMES L., Massachusetts Institute of Technology.

HAYNES, JACK C., University of North Carolina.

HOWIE, VERNON C., University of Saskatchewan.

LAMBE, CLAUDE M., University of North Carolina.

LIN, CHO-YUAN, Pennsylvania State College.

NEW, RYLAND J., University of Toronto.

SIEFERT, AUGUST C., Pennsylvania State College.

SIMPSON, James F., University of Saskatchewan.

WELCH, RICHARD L., University of Saskatchewan.

WELLIVER, WILLIAM E., Pennsylvania State College.

WOODWARD, WALDEN F., University of Alabama.

Membership Workers' Record

Corporation

E. P. Poste 1

Personal

R. S. Bradley	1	R. B. Sosman	3
C. M. Dodd	1	C. L. Thompson	1
E. L. Maxson	1	Office	3

Student

A. F. Greaves-Walker	2	R. J. Montgomery	1
M. Edward Green	1	F. H. Norton	1
E. C. Henry	4	R. B. Sosman	1
T. N. McVay	1	W. G. Worcester	4
		Grand Total	**26**

*Indicates former member of the Society rejoining for 1937.

ROSTER CHANGES DURING NOVEMBER

Corporation

CORTLAND GRINDING WHEELS CO., John A. Plusch (voter), Chester, Mass. (Former voter, C. B. Tilton)

Personal

ALBERY, D. F., 431 Sherman Ave., Evanston, Ill. (Crystal Lake, Ill.)

BENNETT, MYLES P., 1622 Ethel, Alhambra, Calif. (Glendale, Calif.)

BERNS, MILTON H., Blasdell, N. Y. (Hamburg, N. Y.)

BEVIS, RALPH E., Ferro Enamel, S. A., 1642 LaRioja, Avellenada, Buenos Aires, Argentina, S. A. (Cleveland Ohio)

CANFIELD, RUTH, Arts and Crafts Dept., New York University, New York, N. Y. (Friendship, N. Y.)

CHASE, BYRON L., 833 Carondelet, Los Angeles, Calif. (Avalon, Calif.)

CLARK, C. BURTON, 1003 Johnson St., Carlinville, Ill. (Frankfort, Ind.)

DAY, ARTHUR L., 1565 Old Georgetown Rd., Bethesda, Md. (Washington, D. C.)

EATHERTON, C. Z., Porcelier Mfg. Co., South Greensburg, Pa. (formerly in name of William Goodman)

FRAULINI, FELIX, 813 W. Springfield, Urbana, Ill. (Boonville, Mo.)

GROTHUSEN, RALPH H., Moorhead Brick & Tile Co., 5th Ave. & C.G.W.R.R., St. Joseph, Mo. (Ellsworth, Kan.)

HAZEL, JOHN J., Naval Boiler Laboratory, U. S. Navy Yard, Philadelphia, Pa. (Vandalia, Mo.)

INGERSOLL, HARRY, 2037 Las Lunas, Pasadena, Calif. (Los Angeles, Calif.)

LASIER, EMERY L., "Bay View," 19988 E. 14th St., Hayward, Calif. (Niagara Falls, N. Y.)

MOORE, LYMAN M., 245 John St., Oakland, Calif. (Mexico, Mo.)

PETERSEN, G. M., 308 River St., Benton, Ark. (Ames, Iowa)

PORTER, FRANK R., R. R. 2, Crown Point, Ind. (Hammond, Ind.)

ROSS, DONALD W., Laclede-Christy Clay Products Co., St. Louis, Mo. (Washington, Pa.)

ROSSELL, H. A., 1710 Byers Ave., Joplin, Mo. (Christmas, Ariz.)

SHECKLER, KENNETH F., 2519 Linwood Blvd., Kansas City, Mo. (St. Joseph, Mo.)

STAFFORD, W. L., Box 752, East Liverpool, Ohio. (Manville, N. J.)

WEDEMEYER, N. G., 1695 Cambridge Blvd., Columbus, Ohio. (Philadelphia, Pa.)

WHITE, MILO A., JR., Trenton Potteries, Equitable Plant, Trenton, N. J. (Syracuse, N. Y.)

All You Can Do by and through This Society, You Do for *Yourself and Fellow Ceramists*

No Bragging on This Month's Record but Increases of 19 Corporation and 229 Personal Members in Ten Months Could Be Worse

1937 MEMBERSHIP RECORD

Date of Record	Members Paid		Deferred	Subscriptions	Monthly Sales	Total Circulation
	Personal	Corporation				
December 20, 1936	1452	196				
January 20, 1937	1478	199				
February 23, 1937	1579	210	19	515	220	2543
March 29, 1937	1613	212	18	524	220	2587
April 23, 1937	1517	209	29	485	220	2460
May 22, 1937	1541	209	25	501	220	2496
June 22, 1937	1572	211	23	502	220	2528
July 20, 1937	1607	212	20	506	220	2565
August 23, 1937	1634	215	17	509	220	2595
September 23, 1937	1647	217	19	509	220	2612
October 23, 1937	1681	218	16	512	220	2647
November 19, 1937	1694	219	13	512	220	2658

How about decreasing your undistributed profits tax by financing this, your research coöperative?

How about reducing your taxable net income by claiming exemptions of amount of dues and contributions paid to this Society?

Such payments made prior to December 30, 1937, will reduce taxes collectable both from Corporation and Personal Memberships.

Bills are rendered in December so you can thus save and profitably invest your money.

WHY OUR MEMBERS ARE ENTHUSIASTIC FOR FORTIETH ANNUAL MEETING IN NEW ORLEANS

March 27–April 2, 1938

EARL FRAZIER WILL BE THERE

Someone from our organization will be in attendance at the American Ceramic Society Meeting in New Orleans next March.

We think New Orleans is a good place to go, that is, different; and we believe that a very nice Meeting can be held in this city. We have heard several people state that they are planning to attend.

—J. Earl Frazier

ALEX SILVERMAN, ANOTHER REPEATER

I have attended a number of meetings in New Orleans. The city and surrounding country are so interesting that I am always glad to go back.

The old French quarter is especially interesting because of the many antique shops which have glass and pottery for sale. While antique shops generally are inclined to sell reproductions, in many instances, I have found numerous valuable and original glass specimens in my trips through the Vieux Carré.

—Alexander Silverman

BOB KEPLINGER WILL BE THERE

I am delighted with the selection of New Orleans for the Fortieth Annual Meeting of the American Ceramic Society. Some years ago, as Trustee, you will remember I endeavored to promote a Meeting at this same city with, of course, very little success. It seems to me that the location for our Meeting should not be selected primarily because of adjacent or nearby local ceramic plants, which after all should be at least a secondary consideration.

New Orleans should be delightful at that time of the year and, while it is probably the most interesting city in the country and there are a great many things to see and do, it nevertheless offers fewer distractions than New York City, for instance. For the bulk of our membership the transportation is very little, if any, more at this season of the year, to New Orleans than any more centralized location. Also the question of time is possibly of less importance around the first of April for most ceramic manufacturers than it would be either earlier or later.

I believe you will have a well-attended, highly successful meeting and one that will be remembered pleasurably by the members who attend.

—Bob Keplinger

GEORGIA WILL BE THERE WITH AN EXHIBIT

R. W. Smith, our State Geologist, has conferred with Mr. Vaughan and me on the Ceramic Materials Exhibit you are arranging for the New Orleans Meeting of the American Ceramic Society. We shall be glad to take part and hope to make as effective an exhibit as conditions will permit.

—A. V. Henry

MAJOR HOLMES FOR NEW ORLEANS

The Meeting of the American Ceramic Society next year in New Orleans offers an opportunity for the members of the American Ceramic Society to help extend the frontiers, so to speak, of the ceramic profession and the Society, and to help make "ceramic-minded" state officials, business concerns, architects, constructors, and laymen who have not heretofore had the work of the ceramic profession and the American Ceramic Society adequately brought to their attention. In these respects, the Meeting in New Orleans will offer opportunities which do not prevail in ceramic centers where the Meeting has been held frequently in the past.

—M. E. Holmes

SAM SCHOLES IF NEEDS BE WILL THUMB HIS WAY DOWN

Notwithstanding the fact that funds for traveling expenses are vanishingly small in this, as in other ceramic colleges and departments, I am interested in the Fortieth Meeting of the Society to be held in New Orleans, and I plan to go.

This meeting in the deep South, which takes us to that section for the first time since the Atlanta Meeting, can not fail to be a great help in unifying the Society and in spreading the news of its work into that important section. If some of us have to make considerable sacrifice and spend more money to attend, we shall be largely compensated by the pleasure of visiting a new city and by having the feeling of satisfaction in helping to promote the best interests of the Society. There will undoubtedly be a delegation of perhaps six persons from this College.

—S. R. Scholes

GREAVES-WALKER'S REASONS FOR NEW ORLEANS MEETING

It was with a great deal of pleasure that I first received the announcement that the Fortieth Annual Meeting of the Society would be held in New Orleans.

While the Society's membership in the South is not very large, this section of the country is becoming more ceramic-minded as the people realize that it (the South) is becoming increasingly important as a source of ceramic raw materials. A Meeting of the Society will undoubtedly have a good effect, especially in the deep South, where much remains to be done to educate people to use more ceramic products.

It is my belief that at least once in ten years the Society should hold its Annual Meeting in one of the southern states. I am of the opinion that New Orleans will attract a large attendance, as did the Atlanta Meeting of some years ago, and that it will remain in the memory of the members for a long time.

—A. F. Greaves-Walker

OFF TO LOUISIANA IN MARCH, 1938

NELSON TAYLOR FOR NEW ORLEANS MEETING

Why I hope to attend the New Orleans Meeting—

The South has a quality of its own which is one aspect of the American picture. New Orleans is a city with a special personality, recognized by world travelers. As a good American citizen, I want to know my own country better.

In addition to these cultural considerations, I look forward to the New Orleans Meeting because I want to get a better acquaintance with the technical problems of the South, its natural mineral resources, and the application of ceramic products in this region. The southern European countries, particularly of the Mediterranean, have long been friendly to the extensive use of colored tile, terra cotta, and glass in architecture, and the southern states of America, with similar problems of air conditioning and of architectural decoration, should have similar interests.

—Nelson W. Taylor

CHET ENGLE WANTS TO SELL CERAMICS TO NEW ORLEANS

I have read a number of members' letters on the subject of the desirability of going to New Orleans, and I have been impressed quite a little by some of the well-composed letters that were indeed convincing.

I do not recall any which have brought out the particular desirability of our Society showing itself in as many sections of the country as possible.

In other words, the more we can make the American citizen, particularly the women of the land, ceramic conscious, the better it is for our industry. What better way can there be to impress any particular section of the country than by taking ourselves and "our industry," so to speak, forthwith to that particular section with all the dignity, impressiveness, and enthusiasm that we can command?

—Chester C. Engle

G. W. JARMAN, JR., FOR NEW ORLEANS

Aside from the usual reasons for attending a Meeting of the American Ceramic Society wherever it may be held, due to the amount of information that is laid before us all for our absorption, there is the unusual one of killing two birds with one stone, that is, having a winter vacation "while in line of duty," as used to be said in the army. From my knowledge of New Orleans, revisiting it merely enhances its loveliness and I am sure that those who have not visited it will be more than repaid for the slightly more time necessary to spend going down there.

I suggest that some effort be made to inform the people of New Orleans, who are not familiar with the ceramic industry as to cost and development, in the manufacture of the ware which they buy, and when that is tied up with the Meeting itself, I believe the sale of ware can be materially stimulated.

—G. W. Jarman, Jr.

GRANT DIAMOND TESTIFIES

We are very pleased at the selection of New Orleans for the Fortieth Annual Meeting of the American Ceramic Society.

From the standpoint of the Membership Chairman of the Society, we are also pleased to find the Annual Meeting held in outlying districts.

The Society is composed of members from all over the country, and it is only fair that the far-away members have an occasional opportunity of conducting the Meeting. It will also help to develop interest in the Society in such areas.

In addition to this, the selection of New Orleans is very desirable from a personal viewpoint. New Orleans has always been one of those cities which I had hoped some day to visit, due to the interesting history and unique atmosphere.

As for the success of the Meeting held in such a spot, I think that there will be better attendance by all of the members, because there will be less to distract us from the technical discussions.

—Grant S. Diamond

JOE GREGORIUS' ENTHUSIASM

The many previous letters you have published about the attractiveness of the Meeting place for the 1938 Meeting supply ample arguments and persuasions for the excellency of the choice. Anything that I might add would only be a repetition of the very good arguments already presented.

The mileage difference involved does not seem to me to be sufficient to make attendance difficult. Several years ago I happened to be in New Orleans in the same season as our 1938 Meeting is to occur, and I must say that to a northerner the weather was perfectly wonderful, and I can echo the feeling expressed in many of the letters already published that New Orleans is a perfectly charming city.

—J. S. Gregorius

A TEXAN SAYS

The Meeting at New Orleans can be made one of the most important that has ever been held from the standpoint of educational development of the benefits that can be brought to the clay products industry of the Southwest through technical study and development of the resources at hand. You are, of course, fully aware of the lack of development down here other than that which has been carried on by a few progressive individuals. By bringing together as many as possible of the manufacturers, and most of them are small operators, the Meeting offers an excellent possible opening for further development of industry and advancement of the American Ceramic Society in this section.

LOVE IN NEW ORLEANS

We think the selection of New Orleans as the next Meeting place is a very happy choice, particularly at the time selected, March 27 to April 2. We believe that the time and place could not be improved upon.

—L. G. LOVE

GEORGE DENISON'S REASONS FOR APPROVING HOLDING ANNUAL MEETING IN NEW ORLEANS, WEEK OF MARCH 27, 1938

The European Tour of the American Ceramic Society in 1928 stands out in my mind as a revelation in the advantages of gathering new and unfamiliar ideas as well as a distinct privilege in unusual sightseeing. Special groups of this kind are much more likely to be shown the rare and unusual in foreign as well as domestic visits than is the usual single business traveler.

There is the unquestioned opportunity for assimilating novelty viewpoints from the many scattered members brought together on such an expedition. There is also the great value to me of the scheduled talks at the group meetings, a value inestimably increased by sidelights, hints, bits of information, and business gossip, quite visible if one cares to read between the lines.

In "seeing America first," we are attracted to the unusual. New Orleans, like Quebec and Mexico, are samples of foreign culture, more accessible in price and distance than we often realize.

The December *Books in Brief* has a digest of a short popular novel, Mme. Toussant's Wedding Day—a humorous description of the "Cajuns"—Mississippi Delta fisher people, descendants of Evangeline—become a race—quite apart and so foreign to our sort of existence as to be unknown as part of present-day New Orleans.

There are the old French families passing romantic lives in lovely secluded gardens within the gates and courtyards of the old city. A real and kindly interest in both these types so foreign to our experience opens their doors to visitors and becomes a source of pleasure to look back upon from the confusion and routine of our daily business lives.

In such perilous times as these if one is not to stagnate or become callous to the rise and fall of the business pulse, it is most necessary to encourage and gather new ceramic material. One such apparently unimportant item may mean the difference of success or failure in the inevitable changes we are undergoing.

To stay at home and slowly (or quickly) petrify is fatal! To invest in a little pleasure and nerve tonic along with the economic value of a free exchange of ideas is well worth the layout of a personal or business vacation expense account.

This is one time when business and pleasure can be combined to the *n*th degree.

N. B. Wives of Members.

While these are my sentiments, they were ghost-written by Mrs. Denison and reflect her opinions as well—she's no *yes-wife* either.

GEORGE

TOM CURTIS ALWAYS TRAVELS LONG DISTANCES TO ATTEND ANNUAL MEETINGS

We thoroughly approve of New Orleans as a meeting place for the 1938 Meeting for the general reasons that have made it desirable for other engineering societies to hold their annual meetings occasionally in sections of the country that are far distant from headquarters.

Among these reasons may be mentioned the following:

PERSPECTIVE—The average technical man is hampered by a purely local point of view and, in the observation of the progress of many such men in the past fifteen years, it has seemed to us that those who are given the opportunity to travel increase their efficiency in direct proportion to the extent of their travels by reason of a broadened viewpoint and the opportunities thus afforded to ascertain what is being done by their contemporaries in fields distant from their own.

TRAVELING EXPENSES—The somewhat increased cost of transportation, we believe to be offset by the advantages mentioned above and we feel that the man who can afford to take a week away from his business for the purpose of attending the Meeting can also afford the few extra dollars cost of transportation to a more distant point. We furthermore feel that the benefits derived from attending the Annual Meeting thoroughly justifies employers in paying the full expenses of their men to a relatively distant point.

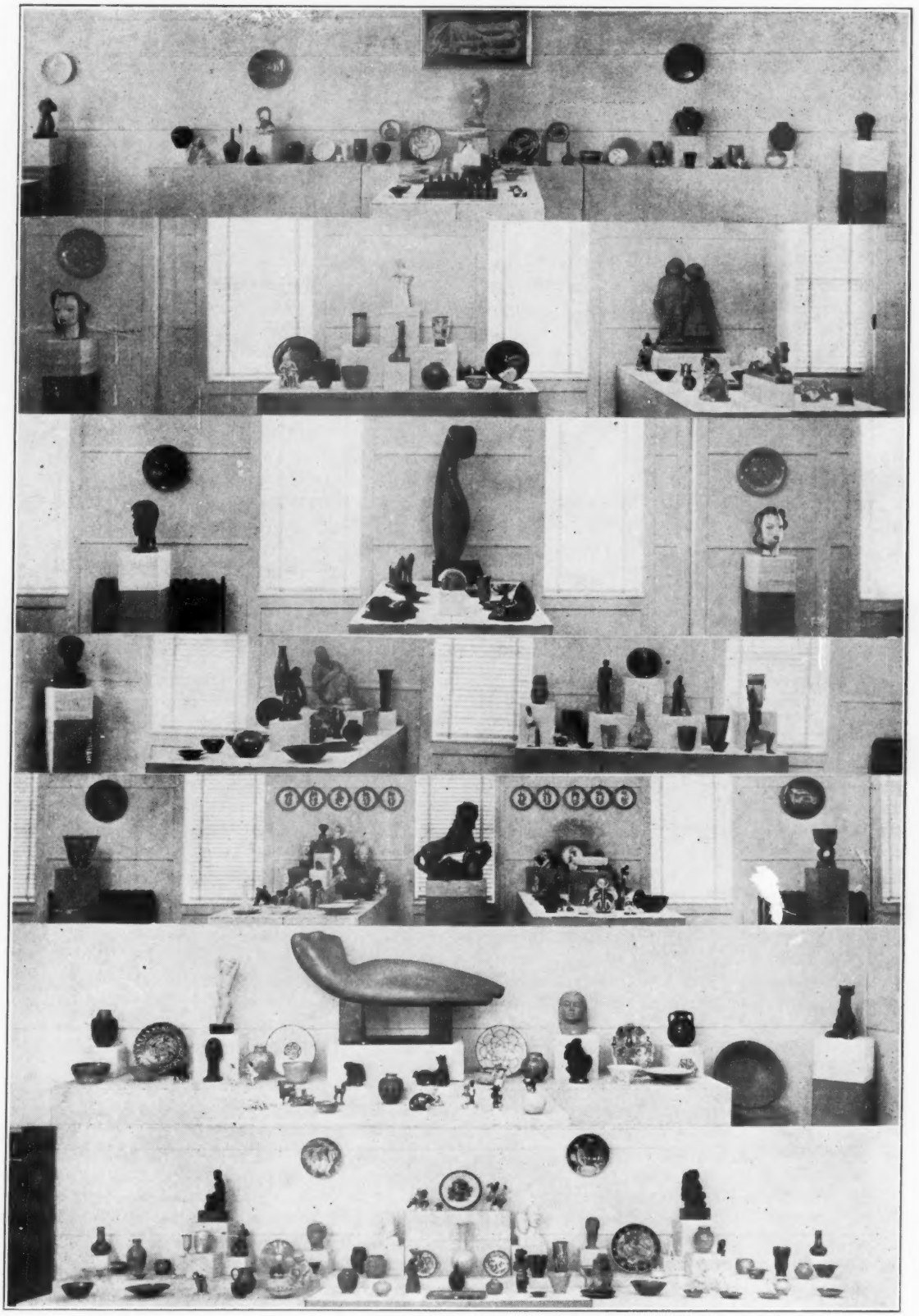
CONCENTRATION OF QUALITY—While attendance at such a distance from headquarters may be somewhat curtailed by virtue of the extra expense it certainly should follow that those who do attend will be the "top-notchers" of the industry, which should make for the greatest possible value in the discussions and conduct of the Meeting and may possibly minimize attendance only of those few who have no serious purpose in mind but who wish merely to obtain a week's leave of absence from their jobs.

The writer has attended more than 70% of all Annual Meetings in the past fifteen years and feels that every one has been a definite investment in education and experience with unquestioned returns. Since this attendance has entailed traveling between two and three thousand miles each way each year for the sole purpose of exchanging ideas at our Annual Meetings, it would seem as though our reasons for favoring New Orleans were backed up by rich personal experience.

—THOMAS S. CURTIS

Membership in
American Ceramic Society

FOR CONTINUING EDUCATION IN CERAMICS



National Ceramic Exhibit to Be at Newcomb College

COMMUNICATIONS—CERAMIC HISTORY

W. E. WELLS, A PIONEER POTTER

In 1871 Homer Laughlin and his brother, Shakespeare, built a two-kiln pottery in East Liverpool under the name Laughlin Brothers. As far as we know this was the first pottery in this country erected to make whiteware exclusively. The growth of the Company was slow and was interrupted in 1879 by a fire that completely destroyed the plant. In 1876, however, the merit of the Company's products was recognized at the Philadelphia Centennial Exposition where they received the highest award. The plant was rebuilt in 1880 largely on capital raised in the community. All the subscribers were given stock, but Mr. Laughlin had so many difficulties with this large group of stockholders that he finally borrowed the money and paid back all of those who had purchased stock.

Shakespeare Laughlin withdrew from the firm about 1885 and the name was then changed to Homer Laughlin China Company.

In 1890 Mr. Laughlin advertised for a bookkeeper, and among the applicants hired was W. E. Wells who was then working for a wholesale drug company in Steubenville, Ohio. Mr. Wells, a young man twenty-six years of age, took the position and within a year was acting as general manager and Mr. Laughlin was devoting a large part of his time to foreign travel.

In 1897 Mr. Laughlin desired to withdraw from the business as he had determined to take up his residence in California. Mr. Wells, with a small group of Pittsburgh capitalists, bought all of Mr. Laughlin's pottery interests. It was shortly after this time that the real growth of the Company commenced.

In 1899, a much larger plant was built in the east end of East Liverpool, and two years later a third plant was built. These three plants together at that time represented a capacity of 32 upright kilns. In 1905, it was again necessary to expand and the large site of Newell, West Virginia, across the river from the lower end of East Liverpool, was purchased. It was necessary, in order to make this site easily available for workmen, to construct a suspension bridge across the Ohio River. This was done by Mr. Wells and a group of associates, and the town site of Newell was laid out. This same group built a street railway line, an electric power plant, and a water plant. The pottery built at that time was then the largest single unit that had ever been erected in the history of the industry either here or abroad. This consisted of thirty kilns under one roof.

The business continued to expand and, in 1914, Plant No. 5, consisting of sixteen kilns, was built adjoining the Newell No. 4 Plant. This brought the total capacity to seventy-eight kilns.

In 1923, it was decided to make the greatest departure in pottery construction that had been attempted up to that date. As a result, Plant No. 6 was erected, which was designed exclusively for tunnel-kiln operation. Tunnel kilns up to that time had been in the experimental stage and it was with considerable misgiving that the more conservative members of the firm entered into this undertaking.

The result was unqualifiedly successful and, in 1927, a duplicate of the No. 6 unit was erected immediately adjoining. Each of these units contained a large Harrop straight-line tunnel bisque and glost kiln with a capacity of approximately 5000 dozen pieces per day. Each of these units also contained a Holcroft continuous-decorating kiln.

Between 1926 and 1928, the original Newell Plant No. 4 was equipped with tunnel kilns to replace the periodic kilns that had been originally built.

In 1928 it was decided to abandon the Plants Nos. 1, 2, and 3 in East Liverpool and, to replace this lost capacity, Plant No. 8 was built adjoining Plants Nos. 6 and 7. This again was the largest producing unit that had ever been built in the industry. The kiln equipment consisted of one large Harrop bisque kiln and two glost kilns of a capacity equal to those of Nos. 6 and 7. This unit also contained two Holcroft decorating kilns. This gave the Company an operating capacity equal to about 120 of the old upright kilns.

Throughout all of this period Mr. Wells had been the active head of the Company and in handling both the labor and legislative problems of the industry had shown genius equal to that in disposing of the products of these large units.

Im 1896, the United States Potters' Association recognized the National Brotherhood of Operative Potters, a branch of the American Federation of Labor, and agreed to deal with them collectively on the matters of wages, hours, and working conditions in the dinnerware industry. In 1900, Mr. Wells was made Chairman of the Labor Committee of the Association and continued to hold this post until his resignation in 1928. During all of that period there was only a single strike of about ten weeks' duration in 1922. We are informed by the officials of the American Federation of Labor that no such record exists in any other industry in this country.

During this period from 1900 until 1930, Mr. Wells was chairman of the Tariff Committee of The United States Potters' Association and personally presented the case of the American potters before the Ways and Means Committee of the House and the Finance Committee of the Senate each time a new tariff bill was being made. It was largely due to his individual efforts that the American potteries are enjoying such tariff protection as they have today.

About 1910 Mr. Wells became interested in the work of the United States Chamber of Commerce and represented at its meetings both the pottery industry and the City of East Liverpool. He attended the meeting in Paris in 1925 when the International Chamber of Commerce was formed.

During all of his active career he was in constant demand as a speaker before organizations of all kinds and never neglected to boost the cause of the American pottery workman and manufacturer.

In January, 1930, Mr. Wells withdrew as active head of The Homer Laughlin China Company and became Chairman of the Board. He died on September 17, 1931.

—J. M. WELLS

NOTES AND NEWS

ANNUAL MINING INSTITUTE, 1938, COLLEGE OF MINES, UNIVERSITY OF WASHINGTON

The Eleventh Annual Mining Institute sponsored by the College of Mines, University of Washington, Seattle, Wash., will be held during the week of January 17–22, 1938. Meetings are scheduled at Mines Laboratory on the University campus each day except Saturday when a field trip is taken to some point of mining or metallurgical interest. Lectures and laboratory demonstrations dealing with mining, metallurgy, ceramics, and related fields are given by members of the staff of the College of Mines. Operators and engineers, prominent in the industry, present subjects dealing directly with operation, and representatives of leading manufacturers display and demonstrate new equipment and machinery. Motion pictures are shown to illustrate current operations.

The various sessions are open to all interested persons. No fees are charged. The meetings are carried on daily according to a prepared schedule that permits attendance at a single or special period or at the entire session. The attendance in 1937 was 284.

Programs and detailed announcements will be issued in fuller form at later dates. Requests for preliminary information should be addressed to Milnor Roberts, Dean, College of Mines, Seattle, Washington.

THE ELIZABETH CLAY HOWALD SCHOLARSHIP

This Scholarship, endowed by the late Ferdinand Howald, an alumnus of the Ohio State University, in memory of his mother, Elizabeth Clay Howald, carries a stipend of $3000, payable in twelve monthly installments.

Any person who has shown marked ability in some field of study and has work in progress, the results of which promise to constitute important additions to our knowledge, shall be deemed eligible to appointment to this Scholarship.

The scholar will be expected to devote his time uninterruptedly to the pursuit of his investigations. If he has ever been a student of the Ohio State University or a member of the University staff, he may carry on his investigations either at the Ohio State University or, subject to the approval of the Graduate Council, elsewhere either in this country or abroad where superior advantages for his particular field of study are available. If the scholar has never had any connection with the Ohio State University, however, then he must carry on his investigations at that University.

Applications must be filed with the Dean of the Graduate School not later than March 1, 1938. The appointment will be made on April 1, and the term of appointment will begin July 1, 1938, and extend to July 1, 1939.

Prospective candidates may secure application blanks by addressing the Dean of the Graduate School, the Ohio State University, Columbus, Ohio.

LABORATORIES FORM AN ASSOCIATION

Representatives of twenty of the principal commercial laboratories of the country, at a meeting in Chicago the week of Nov. 7, completed the organization of the American Council of Commercial Laboratories. One of the purposes of the Council will be the promotion of the proper use of scientific testing methods for the protection and certification of quality in advertised goods.

In behalf of the Council it is stated that the members have been and will be carefully selected to include only organizations to which producers, retailers, and consumers may look for unbiased determinations of quality. Engaging in research and testing for fees, these independent laboratories ascertain and report facts for clients and are uninfluenced by any ulterior consideration.

Laboratories which are adjuncts of other enterprises or which are not self-supporting, or which, for any reason, are not independent, are ineligible for membership in this council.

The following officers and members of an executive committee were elected to serve during 1938: *President*, Preston S. Millar, Electrical Testing Laboratories, New York, N. Y.; *Vice-President*, Monroe L. Patzig, Patzig Testing Laboratories, Des Moines, Iowa; *Secretary*, D. E. Douty, United States Testing Company, Hoboken, N. J.; *Treasurer*, A. R. Ellis, Pittsburgh Testing Laboratory, Pittsburgh, Pa. James H. Herron, The James H. Herron Company, Cleveland, Ohio; F. B. Porter, Southwestern Laboratories, Fort Worth, Texas; and T. A. Wright, Lucius Pitkin, Inc., New York, N. Y., are the members of the executive committee.

MAURACH AND PURDY HONORED AT 21ST BIRTHDAY CELEBRATION, SOCIETY OF GLASS TECHNOLOGY*

Our two great days are now over and I can tell you that everything went happily from start to finish. It was a very happy thing of you to write to us so cordially, and your message was communicated to the general gathering of the Society yesterday morning as a preliminary to all the other events of the day. We had with us in the hall representatives from Germany, France, and Spain, and only ill health or emergency claims prevented the appearance of the Belgian and Czechoslovakian representatives. Delightful messages reached us from R. B. Sosman, F. C. Flint, A. N. Finn, J. C. Hostetter, F. W. Preston, C. W. Parmelee, S. R. Scholes, and quite a number of other friends in the States whose friendship I have treasured for many years.

After the congratulatory messages had been spoken or read, Dr. Maurach, for the Deutsche Glastechnische Gesellschaft, brought greetings from his Society in a very delightful form. All that, we must tell you at a later date.

But immediately after that, I had the honor to make an

* A letter from W. E. S. Turner dated November 11, 1937.

announcement of the result of a specially called meeting of members at which a certain resolution to the Council was considered and approved.

We wanted on our 21st Birthday to give further tangible evidence that we were not unmindful of the great efforts which have been made during many years in sister organizations to stimulate and develop glass technology.

In recognition of the enthusiastic and able work which is proceeding elsewhere in Germany and in America, the Society resolved to elect H. Maurach, Secretary of the Deutsche Glastechnische Gesellschaft, and yourself, my dear Dr. Purdy, as Honorary Fellows of the Society.

We have taken that step both in recognition of special contributions which each of you have made to the field of silicate technology and to the development of organized glass technology as well as in recognition of the work of the two organizations.

It was a special pleasure to me to note the thorough approval with which the announcement was made.

A FITTING TRIBUTE TO J. W. MELLOR, HONORABLE SECRETARY, THE CERAMIC SOCIETY, ENGLAND*

The sixteenth, the final, volume of Mellor has just appeared. It deals with platinum and its compounds and contains a long general index. The completion of this Comprehensive Treatise on Inorganic and Theoretical Chemistry is an event of no little importance in the chemical world. It has taken fifteen years to prepare this work, and there are many features of it that deserve examination and unstinted praise. It is the work of Mellor himself; a committee or team of fifty learned chemists could not have done the work better or so well. Mellor's great industry, great learning, and great literary skill are obvious in every volume, and the treatise will long remain a complete record of our knowledge of inorganic chemistry and an indispensable book of reference.

Those who refer to Mellor, and every student of inorganic chemistry must refer to him, know how full and how accurate is the information so carefully collected by this distinguished author and so skilfully set out. We may say of this book, as was said three hundred years ago of another book, that it is the most perfect and absolute work that ever was written in any humane science, "a work of as absolute perfection in its kind and as free from error as any book that I have known to be written of any humane learning."

We have naturally referred to Mellor on hundreds of occasions and whenever we have done so we have found what seemed to be a reference to every fact worth recording in relation to the subject of our inquiry and known at the time when the volume was published. We have found no bias in the book; the argument is stated and the facts in support of it or refuting it are given clearly and succinctly.

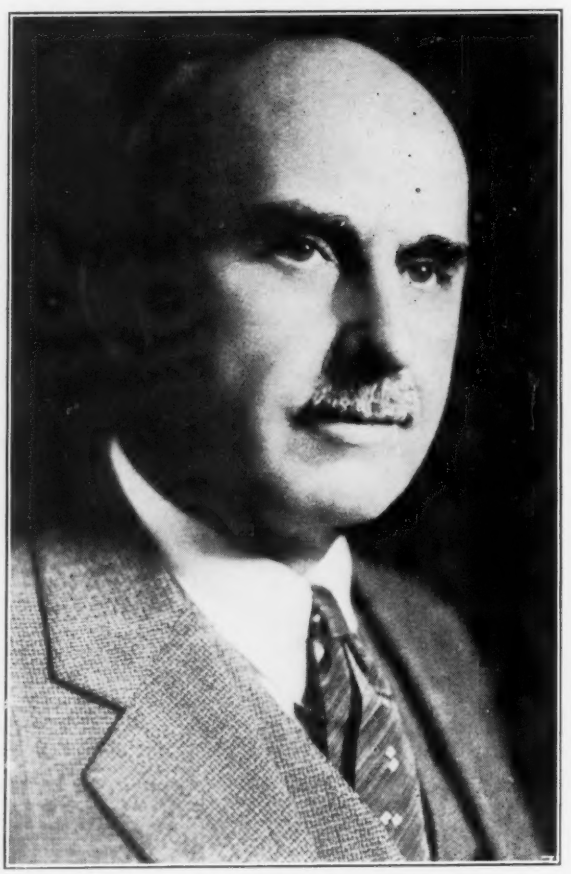
Dr. Mellor's delightful quotations give an insight into the human side of this great author; some of his other writings show how versatile, how amusing, how human he is. He has looked at inorganic chemistry as a whole and "from the mountain top of his exalted wit, saw it himself and showed us it." Mellor is a wonderful achievement; we hope that its author will soon recover his health and long enjoy the fruits of his labour.

We can, we are glad to say, look forward to two supplementary volumes and to a third one dealing with the ill-defined borderland between organic and inorganic chemistry, particularly in connection with some of the carbon compounds of hydrogen and nitrogen. These volumes will deal with matters of much interest in which there have been recent developments of importance. Their publication will be awaited with due impatience. Those who have had the courage to write and publish this great work, more enduring than brass, deserve our congratulations and already have our thanks.

* An editorial in *Chemistry and Industry*, **56** [45] 993 (Nov. 6, 1937).

THE AMERICAN ROLLING MILL COMPANY, MIDDLETOWN, OHIO

More than 200 scientists from all parts of the country were guests of The American Rolling Mill Company at the dedication of Armco's colorful new research laboratories in Middletown, Ohio, on Friday, November 5, 1937.



Anson Hayes, Director of Research Laboratories

"Research is what keeps industry healthily dissatisfied with itself," was the keynote of the dedicatory address by Charles F. Kettering, vice-president in charge of research of General Motors Corporation, at the banquet that concluded the day's activities.

George M. Verity, chairman of the board of Armco, told his audience that "from the courage and brains of men who have refused to accept today's products as representative of 'perfection' has come the impetus that has given us the highest standard of living known in the world and which has provided profitable investment for savings of the nation and work and more abundant opportunities for millions of men."

Charles R. Hook, president of Armco, said that "the real goal of industry is to find new products for old and new uses, so that as industry itself grows, more people will have the jobs and the money to buy these new conveniences. How can we achieve that goal? Research is the key, industry the force that can turn the lock."

Anson Hayes, Armco's director of research, was toastmaster.

During the afternoon, guests inspected the new laboratories. A description of the unique building and a short talk by Mr. Kettering were broadcast over a nation-wide N.B.C. network of stations.

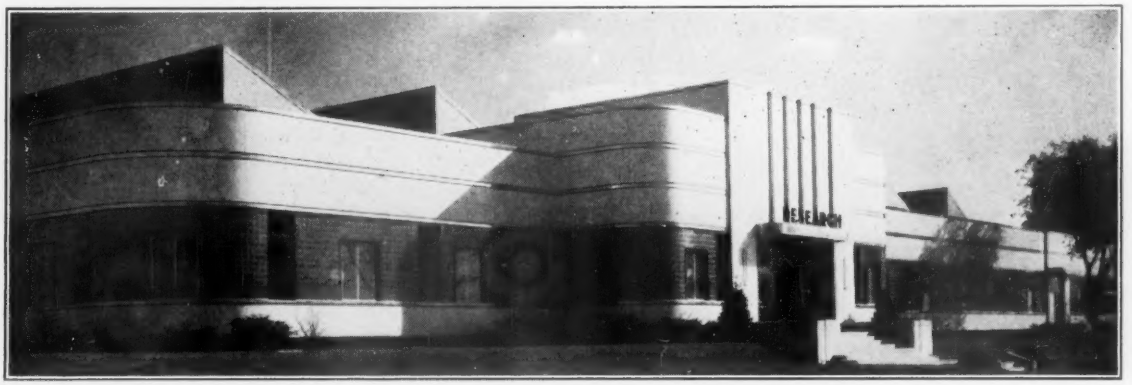
The building, costing $280,000, has a frontage of 255 feet and a dêpth of 175 feet, and provides 43,500 square feet of floor space. It is a sawtooth type with welded steel frame construction of new design. Not a rivet was driven in the structure.

History of Armco

The American Rolling Mill Company began operations in Middletown, Ohio, on February 7, 1901. The founder was George M. Verity, who served as president of the Company until January, 1930, when he became chairman of the board, a post which he still holds.

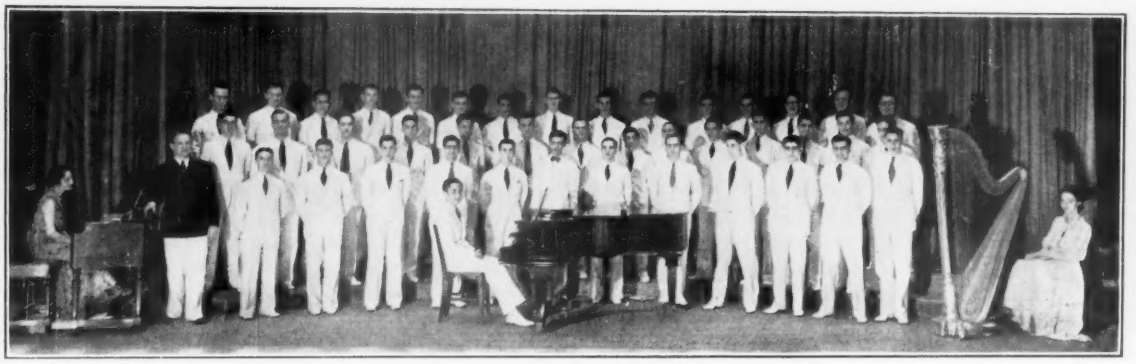
Armco launched its reputation as a pioneer at the outset. Prior to 1901, the various processes in the manufacture of iron and steel sheets were performed in separate and scattered plants. Armco gathered all these processes together, and thus became the first sheet mill to make the transformation from raw material to finished product in a unified cycle in the same plant.

Research in special problems made its initial bow at Armco in 1903, when the Company met the demand of the electrical industry for steel sheets of special magnetic properties. This was followed, in 1906, with the development of commercially pure iron, known as Armco ingot iron. And again in 1912 Armco, tackling the special problem of the growing automobile industry, was among the first to produce a special, high-finish automobile sheet. The next important development was the production of special enameling iron, a metal which could be drawn into intricate shapes and which would grip and hold the glass-like coating of porcelain enamel.



Research Laboratories, The American Rolling Mill Company

TULANE UNIVERSITY HAS MADE ENTERTAINMENT PLANS



Tulane Glee Club on the stage of Dixon Hall, Newcomb College

OLD WORLD MYSTERY AND LAUGHING MASK

No other city in America is like New Orleans and few offer as much to catch the fancy of the visitor.

In New Orleans the visitor finds historical buildings of two centuries ago contrasted with the modern skyscrapers of the present day. He finds many vestiges of the early city lying in the shadows of modern achievements. He finds a unique French Quarter known as the Vieux Carré, Creole cuisine that is different in taste, peculiar customs, a great port, great industries, lovely parks, an ideal climate, and unlimited recreation possibilities.

Unlike most other cities, New Orleans has no Main Street. Its main street is Canal Street, America's widest business thoroughfare and one of the best-lighted. Touching Canal Street is the Vieux Carré, or Old Square, nearly the same today as it was in the days of the Louisiana Purchase. The Vieux Carré is the New Orleans as laid out by Bienville, the city's founder, 216 years ago. In it still can be found the buildings, the entire settings in which the dramas, the romances, and the tragedies of bygone ages were enacted.

Among the noted old buildings in the Vieux Carré are the Cabildo, where the transfer of Louisiana from Spain to France and from France to the United States took place; the St. Louis Cathedral, built in 1794 on the site of Louisiana's first church and still in use; the Pontalba buildings, sumptuous apartments in early New Orleans; the French Market, long one of the traditional spots of peculiar interest; the Archbishopric, erected in 1727, the oldest building in the Mississippi Valley; the Old Absinthe House, where many famous drinks were first made; and the Napoleon House, built for the famous French leader to assist him in his expected escape from St. Helena.

The Vieux Carré is approximately a parallelogram 4000 feet by 1800 feet deep along the Mississippi River. Forts were erected on the four corners of the "square." It is from this humble beginning that New Orleans has grown to be the country's third largest city in area with a land area of 197 square miles.

Many people like to think of New Orleans as an old-world mystery hiding behind a laughing mask. They received that impression because New Orleans is one of the old cities of the country that has preserved many of the relics of the days of long ago. Perhaps they believe that the city is hiding behind a laughing mask because of Mardi Gras when staid bankers and dusty roustabouts doff the habiliments of reality and don the fantastic regalia of a world of make-believe and resign themselves to the wholesome expression of the spirit of play.

But remove that laughing mask and you see the characteristics that have made New Orleans a great city. The people of that 216 year-old city on the Mississippi seem to have born in them the knack of mixing business and pleasure without detriment to either. That they know how to play is evidenced by Mardi Gras. That they also know how to work is proved by the fact that New Orleans is the South's greatest city with a population now near the half-million mark.

New Orleans is an ideal place in which to have a good time, but New Orleans also is a great industrial center with 1400 manufacturing plants that make more than 800 different products. New Orleans' climate permits outdoor sports throughout each month of the year, but that city also is one of the country's greatest ports with inland waterway, coastwise and foreign steamship service to all the important ports of this country and to the ports of the world.

There is much to see and do in New Orleans. Along the river-front you will find 7.26 miles of public docks and warehouses and nearly 6 miles of steel-covered transit sheds, for New Orleans is the gateway for the rich Mississippi Valley and has port and river improvements that are valued at $200,000,000.

Just above the city is the Bonnet Carré Spillway built as a flood relief measure by the federal government. More water can be taken from the Mississippi River at flood stage by the Spillway than passes over Niagara Falls. In that same section is the $13,000,000 bridge across the river. It serves both railroad and vehicular traffic.

Just below the city is Chalmette, where the battle of New Orleans was fought in the War of 1812.

To the north of the city is Lake Pontchartrain, a salt-water body that offers fishing, boating, and bathing.

Near the city are Lafitte, where the pirates had their haunts; the Teche country, made famous by Longfellow in his Evangeline; the Louisiana sugar bowl where most of this country's sugar-cane is grown; the Buras orange section; the Hammond strawberry area; and the noted Mississippi Gulf coast resorts of Bay St. Louis, Gulfport, and Biloxi.

Easily Accessible

Leave Chicago or the middle west after lunch today and be in New Orleans tomorrow for breakfast. Leave New York and points east this evening, have breakfast in New Orleans on the second morning, losing only one business day. Leave the Pacific Coast today and in two days be in New Orleans. In addition, New Orleans is reached overnight from practically anywhere in the country by airplane, or is reached quickly by steamship, bus, or private car.

Conventions and Visitors

No other city in this country is like New Orleans and few others offer as great a magnet for tourists and conventions. Visitors come to New Orleans because of the true spirit of hospitality exhibited, the city's historic association, scenic beauty, mild climate, peculiar customs, and modern achievements.

The year 1938 will be the greatest convention year in the history of the city with tens of thousands of persons scheduled to attend various meetings. The Mardi Gras is of world renown, the Sugar Bowl Classic is a recognized southern institution, the Spring Fiesta holds great prospect, and year-round advantages for tourists are becoming more recognized.

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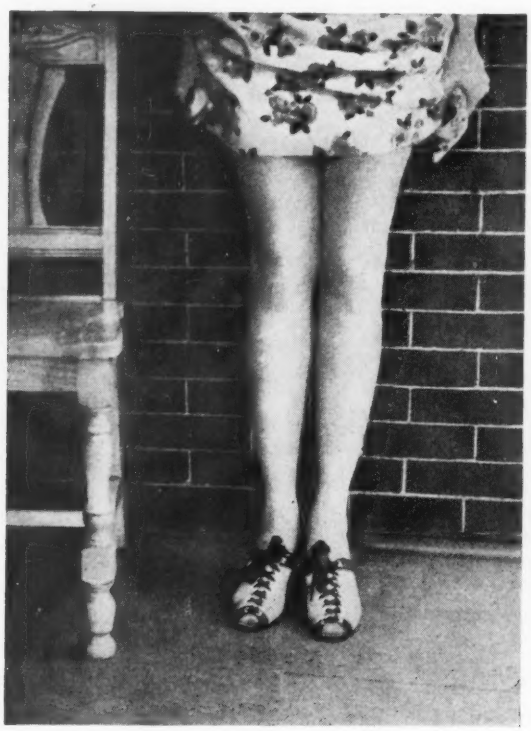

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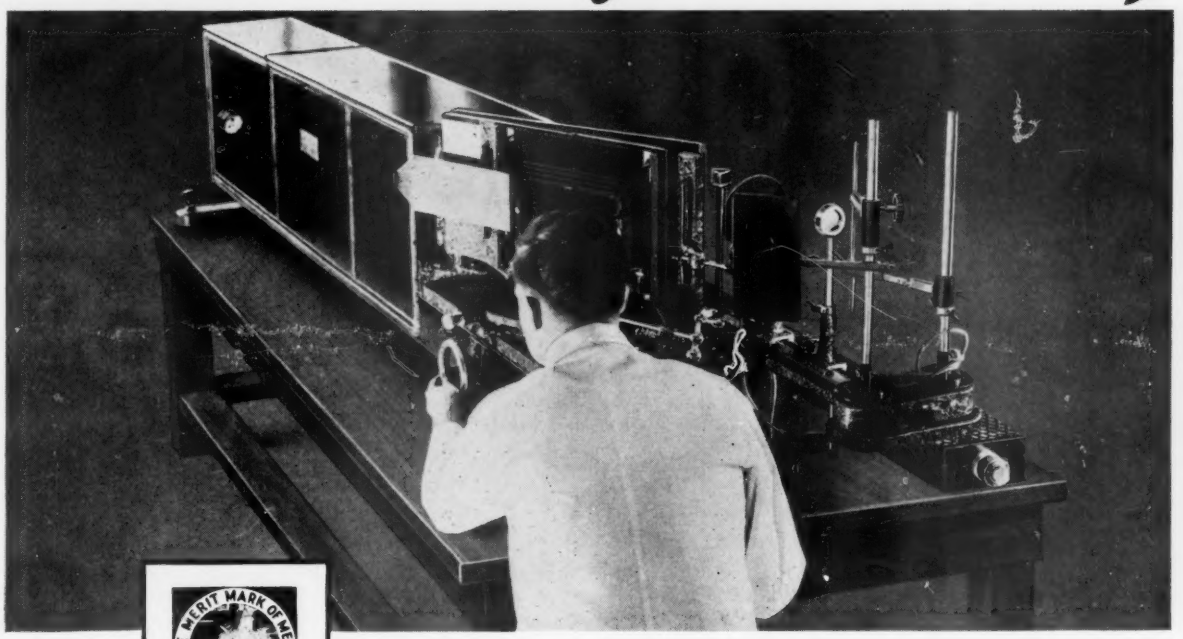

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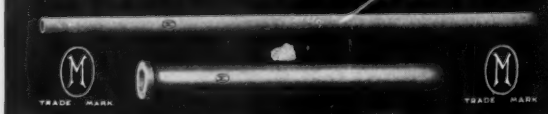
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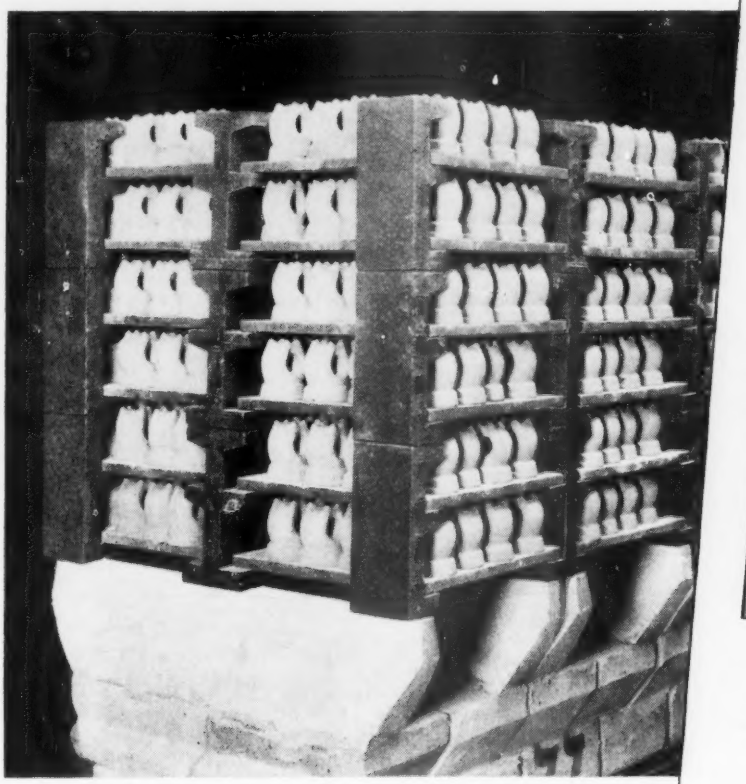

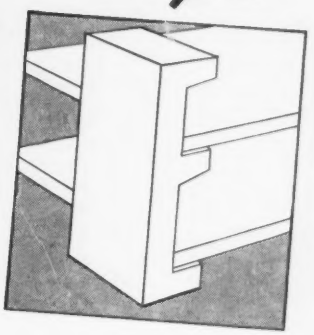

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